

A framework for developing
mine-site completion
criteria in Western Australia

CHAPTER

4

Stakeholder interviews and industry survey

(1 OF 7)

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4 Stakeholder interviews and industry survey

4.1 Introduction

The stakeholder consultation component of this project consisted of two main phases:

1. Stakeholder interviews
2. Industry-wide survey.

These consultation phases were targeted at three broad groups of stakeholders: environmental managers or compliance officers within mining companies, consultants engaged with developing mine closure plans and completion criteria and regulators with experience in assessing mine closure plans or mine completion processes.

The first phase (stakeholder interviews) aimed to understand current industry practices and identify key issues of concern, existing gaps and potential solutions to the development of mine closure criteria in Western Australia. The interview results provided input for development of a wider stakeholder survey (phase two). In this Chapter, we describe the interview and survey methodology and present the results of both.

4.2 Methods

4.2.1 Stakeholder interviews

Interviews were conducted with a range of relevant stakeholders sourced from the Project Industry Advisory Group and word-of-mouth recommendations. The interviews followed a standard methodology referred to as the 'general interview guide' (Daniel 2010). This consists of semi structured questions which allow a high degree of flexibility for the interviewer to adapt questions based on the participants' responses. The indicative interview guide consisted of four parts:

- 1 Decisions about post-mine land use;
- 2 How are completion criteria currently defined (including attributes and references used);
- 3 Risk assessment and monitoring practices;
- 4 The process of mine closure planning in Western Australia (including coordination with regulators and resource availability).

The open-ended nature of the questions can prompt participants to provide narrative, descriptive answers. The main advantage of this method for our specific research purpose is that it allowed interviewees to provide new insights into the topic, which may not have been previously mapped by the researchers.

Potential interviewees were invited via email and, if agreeing to an interview, a suitable date and time was identified with the lead researchers. Human Ethics approval was provided by the University of Western Australia's Human Research Ethics Office (RA/4/20/4241). Approximately half of the interviews were conducted with two researchers present. However, due to planning constraints, it was not possible for both researchers to be available for all interviews. If consent was provided by the interviewee, the interview was recorded. All interviews were transcribed and reviewed by both researchers after completion.



Photo courtesy: DWER

The aim of the interviews was to understand stakeholders' perspectives in relation to current practices for developing completion criteria. In particular, the objective was to identify existing issues which the framework would try to address; as well as positive experiences that would serve to inform the framework's content. Qualitative answers were systematically analysed employing the SWOT method, which evaluates Strengths, Weaknesses, Opportunities, and Threats associated with the question of study (Jackson *et al.* 2003; Pickton & Wright 1998). These four dimensions served to analyse an organisation's internal and external environments, as well as identify positive and negative impact factors (Source: Adapted from Yüksel and Dagdeviren (2007) Figure 4.1).

		IMPACT	
		Positive	Negative
ORIGIN	Internal	Strength	Weakness
	External	Opportunity	Threat

Source: Adapted from Yüksel and Dagdeviren (2007)

FIGURE 4.1 SWOT analysis diagram

4.2.2 Industry survey

Respondents to the wider stakeholder survey were identified through professional networks of the project staff, word-of-mouth and from publicly available information such as company websites, mine closure reports (e.g. authors of mine closure plans, and published literature such as Mine Closure Conference proceedings). Each stakeholder group received similar questions (multiple choice and open answer questions) addressing the topics listed below. Because some questions were phrased differently for different stakeholders, and depending on a respondent's answers to previous questions (and subsequent skip logic), the number of questions shown to respondents in each section varied:

- Screening to ensure respondents met the selection criteria i.e. being involved in developing, advising on or approving mine completion criteria and/or closure plans (4 questions);
- Stakeholder organisation, such as mining business, consultancy firm, or regulatory body. Also questions about predominant minerals mined or consulted for, and approximate company size (2–3 questions);
- Completion criteria: Industry members were asked to base their responses on a specific site they had worked at, while consultants and regulators were asked to answer the questions for the majority of closure plans developed or reviewed (10–16 questions);
- Monitoring and evaluating progress towards completion criteria, such as the references and methods that are typically used (3–9 questions);
- Coordination within the organisation and engagement with other organisations (4–6 questions);
- The final section asked about available resources for the development of completion criteria and invited respondents to submit any additional comments (4–6 questions).

The survey was programmed in the Qualtrics survey software. Potential respondents were invited via email through an anonymous survey link. The initial survey invitation was sent to 100 valid email addresses. Respondents were asked to distribute the link to other members of their team(s) involved in mine closure or in developing mine completion criteria. Because the software system does not keep count of forwarded surveys (only those completed), we cannot identify precise survey response rates. A total of 75 completed surveys were returned, which is indicative of experts' willingness to contribute to this research and the perceived importance of the topic.

4.3 Results

4.3.1 Interview results

Between February and May 2018, 17 interviews were conducted with regulators (4), consultants (5), and mining companies (8). Some organisations had more than one person taking part in the interviews, which resulted in a total of 26 stakeholders being interviewed.

For each of the 17 organisations interviewed, key strengths, weaknesses, opportunities and threats were identified (Source: Adapted from Yüksel and Dağdeviren (2007) Figure 4.1 above). A large number of *threats* were identified, as participants more often articulated negative external factors, rather than internal limitations. However, a few organisations also described their *weaknesses* which, in some cases, coincided with *threats* identified by others (e.g. lack of coordination between teams within the same organisation). During the data analysis, it became apparent that certain issues recurrently appeared across several interviews. Interestingly, such commonality in responses highlighted several key points of agreement across regulators, consultants and mining companies.

The narrative responses were synthesised into groups of information representing common ideas — an approach known as thematic analysis (Boyatzis 1998). While there is no formal restriction on the number of themes, Creswell (2013) and Lichtman (2012) indicate that qualitative information should typically be categorised into five to seven main concepts. In our study, six key themes were identified: end land use; coordination; completion criteria; monitoring; capacity; and processes. Each of these key themes comprised several sub themes on particular issues (Table 4.1). Most commonly mentioned was the disconnect and disagreement among various Government departments. This issue is clearly illustrated by the experience shared by one mining company:

“For our mines operating on Crown Land, approval from DMIRS is needed. DMIRS will liaise with other departments, such as EPA, DBCA, Water, Housing, DPLH, Local Government Authorities (LGAs), among others. In one of our sites, contradicting demands from different departments resulted in a Mexican standoff between LGAs, DPLH, and DBCA. There are too many agencies we have to interact with, they all have their own ideas and agenda.”

The other common highlighted issues were: the lack of government capacity; lack of incentives for companies; liability associated with ‘alternative’ post-mining land uses; and a too narrow focus on ecological, numerical targets. As one industry proponent explained “Completion criteria are very environmentally focussed, which creates a contradiction between EPA (prioritising ecosystem restoration) and DMIRS (focusing on ‘safe, stable and non-polluting’).” A consultant also noted that “Completion criteria are typically written by environmental consultants — not land planners, which is why mine closure plans are limited in scope”.

Other important challenges identified by interviewees were inconsistencies between teams within the same stakeholder group (both within companies and between government departments) and contradictions in preferred post-mining land use between stakeholders and regulators.

Several interviewees identified positive aspects (summarised in Table 4.2). Each of the eight mining companies, as well as one regulator and one consultant, praised their internal knowledge and practices as key strengths. For example, one representative of a mining company explained that “Our rehabilitation uses best practices to optimise outcomes, so we are able to meet our completion criteria”. Another company noted that “As our mine sites are relatively new, we are able to do things right from the start. We have enough internal resources, as well as an education program about the importance of rehabilitation”.

The second most commonly mentioned positive aspect was the regulators’ recent and gradual shift in mindset, chiefly regarding the acceptance of different PMLUs and reference sites. As one mining proponent explained “Increasingly, it is being recognised that expectations for pre-mining uses are unrealistic”.

Other positive messages included the benefits obtained from knowledge sharing between mining companies and the substantial monitoring improvements offered by emerging technologies (e.g. drones). Contrary to expectations about government resources, one consultant and one mining company notes that the regulators’ level of knowledge and advice were adequate for industry to develop completion criteria. In the words of one interviewee, “There is enough guidance from the regulator — more would be too prescriptive”.

TABLE 4.1 Common themes, weaknesses, and threats identified through thematic analysis of interview data

Common themes	Weaknesses and threats	Times mentioned (n=17)
Post-mining land use (PMLU)	Limited consideration of PMLU, other than reverting to pre-mining land use	4
	Lack of guidelines on how to select PMLU	1
	Contradiction of preferred PMLU between regulators and stakeholders	6
	Lack of consultation with land planning	2
Coordination	Disconnection between approvals team (early stages of mine closure planning) and completion/rehabilitation team (final stages of mine closure planning)	7
	Disconnection and disagreements among various Government departments	11
	Inconsistent guidance given by regulators over time and across staff members	6
	Limited knowledge sharing among mining companies	2
Completion criteria	Rehabilitating to "what was there before" is ecologically impossible and financially infeasible	4
	Lack of guidance to define SMART ¹ criteria and criteria for 'self-sustaining ecosystem'	4
	Benchmarking against analogue sites is unrealistic, particularly for hard-rock mining	4
	Too narrow focus on numerical targets and ecological aspects, with little consideration for overall rehabilitation success or safe, stable, non-polluting aspects	8
	Risk should be incorporated in development of completion criteria (and monitoring)	3
	No policy on rehabilitation	4
Monitoring	Lack in monitoring guidelines (particularly on new technologies) and limited monitoring consistency	5
	Monitoring is often untargeted and not matched against completion criteria	2
	Monitoring should be time-bound	3
Capacity	Competency gap within the Government to assess various closure aspects (engineering, safety, pollution, biodiversity, community, long-term planning etc.)	8
	Lack of incentives for companies to invest in closure planning and achieve high rehabilitation outcomes	8
Processes	Residual risk (liability) linked to alternative land uses is a main impediment to relinquishment/alternative land uses	8
	Important differences between older (previously mined) and new sites; shallow and hard-rock mining; big and small companies; under Mining Act and under State/ Ministerial Agreements	5

¹ Specific, Measurable, Achievable, Relevant and Time-bound

TABLE 4.2 Common strengths and opportunities identified through thematic analysis of interview data

Strengths and opportunities	Times mentioned
Good internal knowledge and practices	10
Regulators are becoming more open to new ideas, e.g. alternate PMLU	5
Advances in technology help monitoring	2
Knowledge sharing among mining companies	2
The regulator's level of knowledge and guidance provided are adequate	2

4.3.2 Survey results

The industry survey was completed by 75 respondents, of which the majority (55%) were mining industry employees, and the rest were either consultants in the field or government employees involved with mine closure, mine rehabilitation, or completion criteria (Table 4.3).

TABLE 4.3 Number of survey respondents by stakeholder group

Stakeholder group	Number of respondents
Mining industry	41 (55%)
Consulting business	18 (24%)
Government agency	16 (21%)
Total respondents	75

4.3.3 Sample characteristics

Of the mining industry members, the majority were involved in iron ore, gold or basic raw materials operations (Figure 4.2), with operations spread across all regions of Western Australia. Company operating revenues ranged from less than A\$1 million (three respondents) to more than A\$5 billion in the 2016-17 financial year (nine respondents). On average, the operating revenue of responding companies was between one and five billion (Appendix 4.5.1).

The majority of the consulting businesses surveyed advised for gold mines, iron ore or mineral sand miners (Figure 4.2). Consulting businesses of different sizes were surveyed, ranging from sole traders (22%), small local businesses (45%), to large international companies (28%).

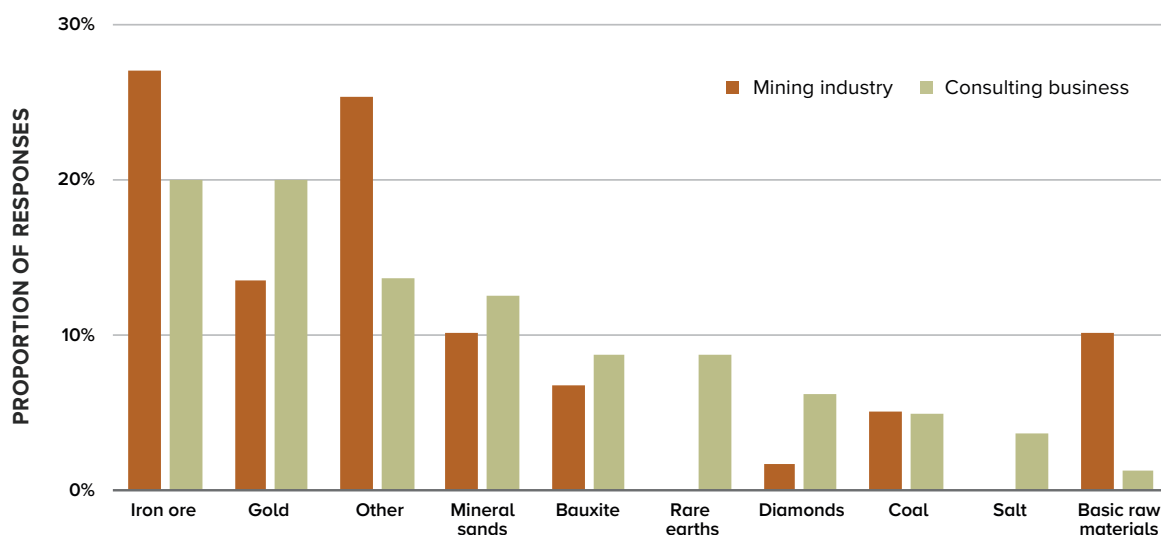


FIGURE 4.2 Main minerals and raw materials represented in stakeholder survey

Respondents from government agencies (henceforth ‘regulators’) came from the Department of Biodiversity, Conservation and Attractions (DBCA; six respondents); Department of Mines, Industry Regulation and Safety (DMIRS; three respondents); Department of Water and Environmental Regulation (DWER; three respondents); and the Department of Planning, Lands and Heritage (DPLH; two respondents). Two regulators did not state which agency they were affiliated with.

Industry members were asked to think about a specific mine site when completing the questions about completion criteria. The majority of the selected sites (73%) are currently in operation, including four sites under post-closure management. Selected sites are located on land that was previously tenured under pastoral leases, unallocated crown land, private land or native title (Table 4.4). Correspondingly, pre-mining land use was predominantly pastoral or natural ecosystem. The anticipated post-mining land uses were also predominantly pastoral and natural ecosystem/conservation (Table 4.4).

TABLE 4.4 Tenure, pre-mining land use and post-mining land use of the sites considered by survey respondents when completing questions about completion criteria

	Tenure prior to mine lease		Pre-mining land use	Post-mining land use
Pastoral lease	35.7%	Pastoral	44.6%	34.7%
Unallocated crown land	25.7%	Natural ecosystem	30.4%	26.4%
Private land	12.9%	Forestry	10.7%	5.6%
Native title	11.4%	Agriculture	8.9%	8.3%
Forestry reserves	8.6%	Recreation	1.8%	8.3%
Reserve land	5.7%	Industrial or commercial	–	5.6%
		Energy generation	–	2.8%
		Other	3.6%	8.3%

4.3.4 Post-mining land use decisions

Both industry and consultants were asked how they typically determine post-mining land uses. For mining industry employees, post-mining land uses are typically determined through negotiations with local communities or regulators (13% and 27% respectively), or are based on what was there before (37%) (Figure 4.3). Five respondents (7.5%) stated that they use landscape capability assessments, and eight respondents (12%) use multi-criteria analysis to decide on post-mining land use at their selected site.

For consultants, post-mining land uses are mostly negotiated with the regulator, client or local communities (19%, 19% and 16% respectively). Seven respondents (11%) stated that they use landscape capability assessments, while multi-criteria analysis is used by five respondents (8%).

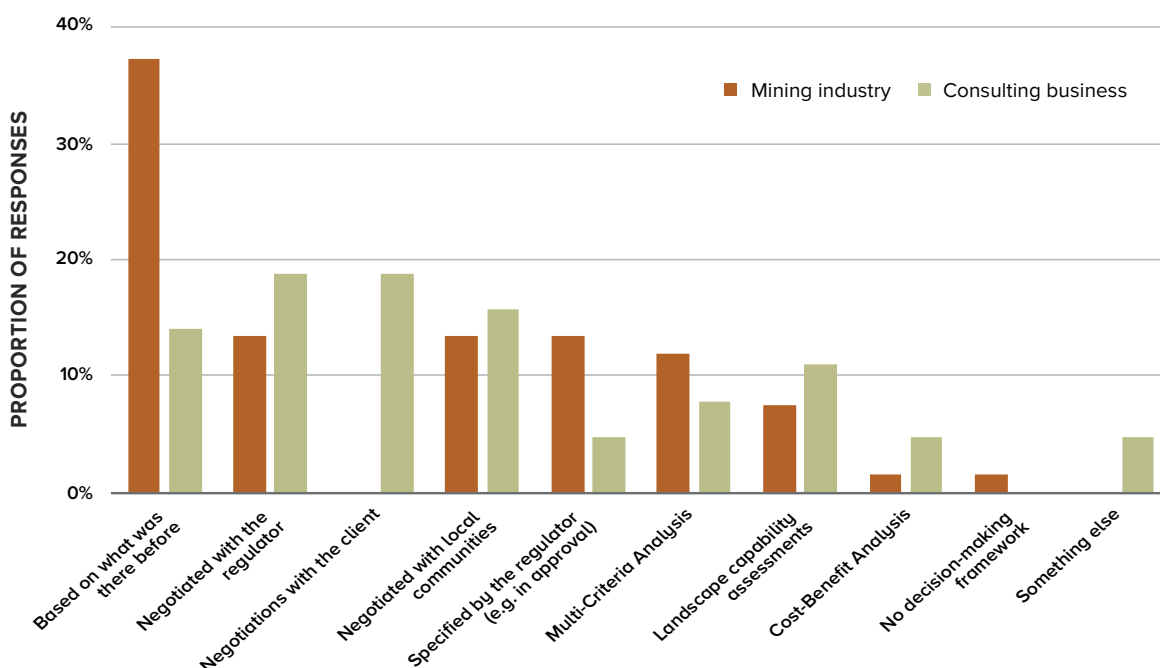


FIGURE 4.3 Decision processes used by survey respondents to determine post-mining land use

4.3.5 Developing completion criteria

Industry members and consultants use similar information sources to guide the development of completion criteria. The most often mentioned guidelines were the Department of Mines and Petroleum’s (now DMIRS) *Guidelines for Preparing Mine Closure Plans* (DMP & EPA 2015), followed by various sources of knowledge internal to the own organisation or closure plans from other companies (Table 4.5). Only a minority of respondents use other guiding documents from Government bodies and independent expert organisations (EPA 2006a, 2016f; LPSDP 2016a, 2016b; SERA 2017).

TABLE 4.5 Information source(s) used by survey respondents to guide the development of completion criteria

What information source(s) do you use to guide the development of completion criteria? (tick as many as apply)	Mining industry		Consulting	
	% of resp.	# of resp.	% of resp.	# of resp.
Guidelines for Preparing Mine Closure Plans (DMP & EPA 2015)	19%	31	16%	16
Our rehabilitation team's knowledge	16%	26	14%	14
Our previous closure plans	15%	24	12%	12
Internal guidelines	10%	17	4%	4
Closure plans from others	9%	14	5%	5
Our approvals team's knowledge	7%	12	9%	9
Mine Closure Leading Practice Handbook (LPSDP 2016a)	5%	8	8%	8
EPA Environmental Factor Guidelines (EPA 2016a)	4%	7	8%	8
Mine Rehabilitation Leading Practice Handbook (LPSDP 2006e)	4%	7	7%	7
EPA Guidance “Rehabilitation of Terrestrial Ecosystems” (EPA 2006)	4%	6	7%	7
SERA Standards for Ecological Restoration (SERA 2017)	1%	1	5%	5
Other	6%	9	4%	4
Don't know	1%	1	0%	0
Total number of responses	100%	163	100%	99

An open question was used to assess how industry and consultants make sure that completion criteria are SMART (specific, measurable, achievable, relevant, time-bound). Most of respondents explained that they aimed to base completion criteria on measurable/quantifiable variables, with a reference/target specified. Such measurable attributes are typically:

- Determined through an iterative process where completion criteria are reviewed by the proponent, consultant and/or regulator before agreement is reached;
- Based on company’s experience; or
- Based on monitoring data and available scientific evidence.

For example, one respondent stated that they “develop an indicative monitoring program to ensure all aspects can be measured and have a defined end point”, while another respondent aimed to base completion criteria “around factors that can be measured”. Respondents provided multiple examples of measurable attributes used to assess progress towards completion criteria (Table 4.6).

Note that some indicators were expressed in a qualitative manner (e.g. ‘vegetation is sustainable’), which are typically more difficult to measure than indicators with quantitative metrics. Nevertheless, some respondents explained how they define qualitative attributes with measurable metrics. Take, for example, the completion criterion ‘number of key plant species is within the historically observed reference range’. This respondent defines ‘key plant species’ as those species that have 80th percentile dominance by total coverage or individual plant count in vegetation units as defined by the relevant flora survey. ‘Reference range’ is defined with respect to individual key plant species as plants per hectare by monitoring reference sites quadrats or comparative photo-points over time.

TABLE 4.6 Examples of metrics used to assess progress towards completion criteria provided by survey respondents

1. Example attributes with measurable / quantitative metrics
• Percentage (%) vegetation cover in rehabilitation areas
• Percentage (%) native perennial vegetation cover
• Percentage (%) species representation, relative to analogue sites or surrounding, unmined, areas
• Species diversity (total no. perennial species) at $\geq 50\%$ of the mean value from the analogue sites in the target ecosystem
• Species density (total no. perennial plants) at $\geq 50\%$ of the mean value from the analogue sites in the target ecosystem
• Density of native (non-legume) plant species (number/m ²)
• Density of leguminous understorey species (species/m ²) as measured approx. 1 year after rehabilitation establishment
• Minimum (and maximum) density of trees (stems/ha)
• Average weed foliage cover (%) is no more than 2% as compared with forest control plots
• Weeds shall compromise less than 5% of revegetated areas
• No areas greater than 0.1 hectare with less than 1 native plants per m ² as measured approx. 2 and 10 years after rehabilitation
• Gully width and depth (m)
• Level of erosion (using AER erosion severity class scale, max. 2 or 3)
• Average erosion rates are below x t/ha.yr
• Absence of active gully erosion measured using either ground-based photography or aerial imagery
• No visible sediment deposition beyond containment structures
• Water quality in streams at a minimum level (concentration TSS, N, P) for three consecutive years after remove of mechanical intervention
• Mean LFA infiltration and nutrient cycling rating of $\geq 50\%$ of the value of the analogue sites in the target ecosystem over three consecutive monitoring periods (for annual monitoring) or two consecutive monitoring periods (for biennial monitoring)
• LFA stability of rehabilitated waste rock landform achieves or exceeds an overall slope stability safety factor of 1.5
• Mean LFA nutrient and infiltration levels achieved are 70% of those of similar analogue environments in the surrounding region
2. Example attributes with qualitative metrics
• Future land owners'/community's level of acceptance of post-mining land use
• Landforms are safe and stable
• Landform design is compatible with agreed future land use
• Using EFA to identify the point of inflection where performance is moving towards sustainability
• Vegetation is sustainable and resilient to likely impacts such as drought, fire and grazing
• Recruitment of native perennial species is occurring or is likely to occur on the site
• Perennial plant cover in rehabilitated areas reach x% of the best achievable on the site
• Weed cover is less than long-lived perennial plant cover

Several mining industry respondents emphasised that their current completion criteria may still be broadly indicative criteria that are not yet SMART. Such completion criteria will be refined as more information becomes available leading up to closure. Three respondents noted that, because of this, time-bound criteria are not always possible or relevant. Having a time-bound criterion suggests that there is a limited time frame to achieve completion, which is not realistic with rehabilitation as an ongoing process.

Similar to results obtained in the interviews, it was suggested that criteria should be more process rather than outcome based, because it is uncertain whether defined outcomes can be attained. ‘Process-based’ completion criteria are those that focus on rehabilitation practices or inputs, rather than final outcomes. This has a parallel in the construction of leading versus lagging indicators (Section 3.6). For instance, setting a standard for way the site is prepared to provide the conditions required for restoration/rehabilitation, such as building fauna habitat, would be a process-based criterion, as opposed to fauna count, which is an outcome-based indicator. Similarly, interviewees expressed an interest in having completion criteria set in a time-bound manner, whereby targeted levels of performance (e.g. indices of vegetation development) would be set along a trajectory towards the agreed closure outcome.

Interestingly, about one third of regulators stated that the majority of mine closure plans lack detailed completion criteria, and more than half of regulators said that most plans do not contain measurable indicators. Government respondents stressed that the level of detail in completion criteria and indicators varies greatly between sites and companies (Table 4.7 or Figure 4.4).

TABLE 4.7 Respondents’ answers related to mine closure plans details and indicators

	In general, are the completion criteria in mine closure plans sufficiently detailed and site specific?		In general, do the completion criteria in mine closure plans have measurable indicators against each criteria?	
	% of resp.	# of resp.	% of resp.	# of resp.
The majority of the plans I see have detailed and specific CC/measurable indicators	0%	0	7%	1
This varies greatly between sites	13%	2	7%	1
This varies greatly between companies	53%	8	29%	4
The majority of the plans I see lack detail in their CC/measurable indicators	33%	5	57%	8
Total number of answers provided	100%	15	100%	14

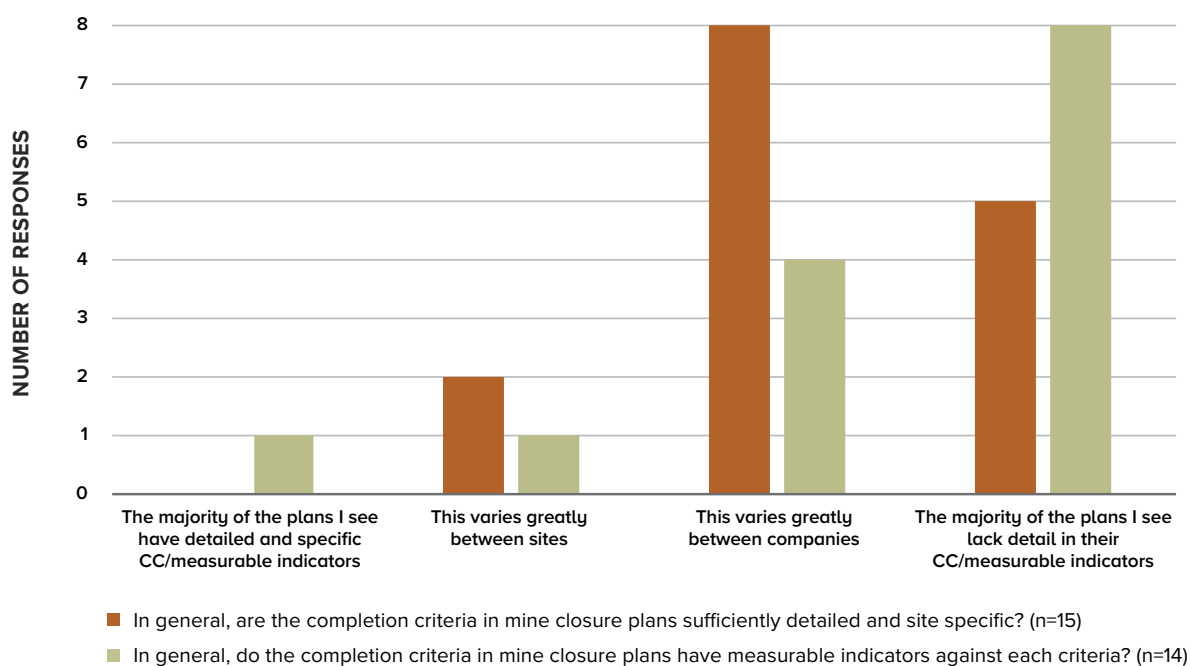


FIGURE 4.4 Level of detail provided in mine closure plans (number of responses by regulators)

The issue of achievability was raised by all three stakeholder groups. Eight industry and consulting respondents emphasised the difficulty in defining achievable criteria, because of the gaps in knowing what ecological restoration is feasibly achievable in Western Australia. For example, one industry respondent stated that “Current criteria were written during approval phase and do not meet SMART criteria, and are in their current form unachievable”. Another respondent pointed at the difficulties of defining closure criteria for historical disturbance where baseline studies are absent.

Out of 15 regulator respondents, 14 agreed that, in general, completion criteria defined in mine closure plans are not achievable. This is mostly because (a) closure plans are still ‘under development’; (b) completion objectives are generally non-specific without providing auditable detail. Consistent with the interview results, one respondent commented that “Completion criteria are usually written to make sure they can be complied with but are too ambiguous for accountability. They are designed to get approval for the development of the closure plan from regulators rather than to satisfy the land manager”.

All three stakeholder groups (mining industry, consultants and regulators) answered a question about the major challenges encountered when developing or assessing completion criteria. Respondents were shown eight potential challenges, which they ranked from 1 (most important) to 8 (least important).

As shown in Figure 4.5, the most important challenge for all stakeholder groups is the lack in data to develop evidence-based completion criteria. This is consistent with other comments in the survey, where respondents noted that there is still insufficient knowledge about rehabilitation and ecological restoration in Western Australia. Feedback from participants indicated that more guidance on how to set appropriate and realistic completion criteria that are agreed amongst stakeholders is needed to help further the industry.

Student t-tests were used to test for differences between stakeholders and between mining businesses of different sizes. These tests showed that there were some statistically significant differences in assessments between stakeholders. “Government departments all set different standards” and “The regulator imposes additional standards on previously approved criteria” are significantly more important to mining industry than to the other two stakeholder groups ($p < 0.05$). “We have no appropriate reference to benchmark achievement against” is significantly more important to regulators than to the other stakeholders ($p < 0.05$). Another important challenge to consultants and regulators is “Alternative post-mining land uses are not adequately explored” (no significant difference).

We also tested whether differently sized mining and consultancy businesses placed more or less importance on the challenges listed in the survey question. The only statistically significant difference between companies is the higher importance placed by small mining companies (less than \$100 million operating revenue) on “The regulator imposes additional standards on previously approved completion criteria” compared to mid-size ($p = 0.06$) and large mining companies ($p = 0.013$).



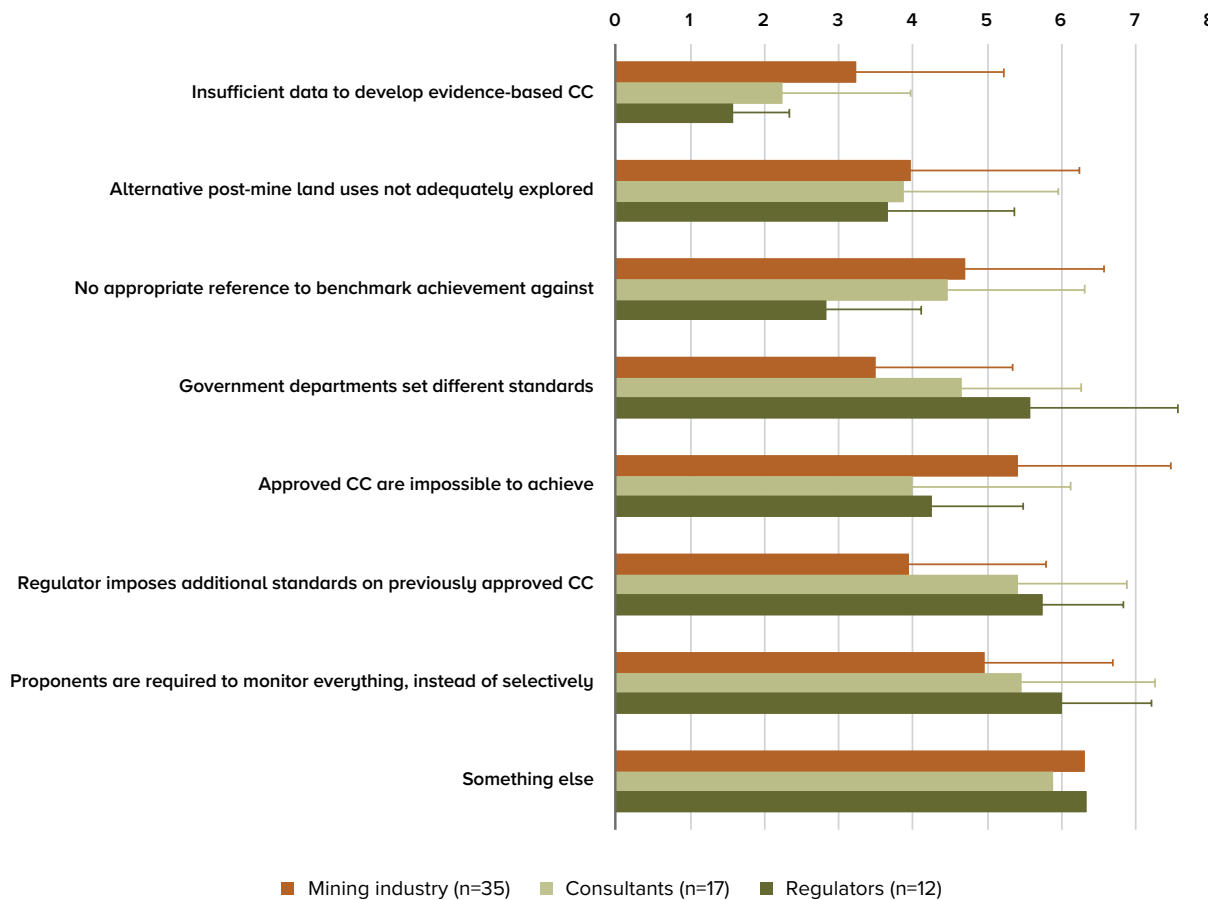


FIGURE 4.5 Challenges when developing completion criteria
 Mean estimate for each stakeholder groups; 1 = most important, 8 = least important;
 Error bars show standard deviations

4.3.6 Risks

An open question to mining industry respondents was about the most important ramification of not meeting current completion criteria. Answers included: an inability to relinquish tenure and liability (mentioned by 11/31 mining respondents); financial implications of costly remedial works (mentioned by 11/31 mining respondents); and reputational risks to a firm’s social licence to operate (mentioned by 10/31 mining respondents). Four respondents explicitly stated minimising environmental and safety risks as a primary goal of rehabilitation, and that not meeting those criteria can reduce stakeholder support affecting future regulatory approval.

The main risks taken into account are very similar across all three stakeholder groups. Most important are financial risks, erosion, failure to establish vegetation, and ground or surface water impacts (Table 4.8). Community preferences, litigation and cumulative risks were mentioned least often. There are some variations between responses by the regulators and the other two stakeholder groups: acid drainage, climate change and cumulative risks are more important to regulators than to mining industry and consultants. Financial risks, regulatory changes and community preferences are mentioned less often by regulators compared to mining industry and consultants.

TABLE 4.8 Risks taken into account when developing / advising on completion criteria
Number of times mentioned are provided with percentage of total per stakeholder group in parentheses

What information source(s) do you use to guide the development of completion criteria? (tick as many as apply)	Industry # responses (%)	Consultants # responses (%)	Consulting # responses (%)	Total times mentioned
Financial risks (e.g. company resources)	24 (7.2%)	11 (7.5%)	12 (8.3%)	47
Erosion risks	24 (7.2%)	11 (7.5%)	11 (7.6%)	46
Failure of vegetation establishment	25 (7.5%)	9 (6.1%)	12 (8.3%)	46
Impacts on groundwater	24 (7.2%)	10 (6.8%)	11 (7.6%)	45
Impacts on surface water	26 (7.8%)	9 (6.1%)	6 (4.1%)	41
Regulatory changes	20 (6.0%)	9 (6.1%)	11 (7.6%)	40
Acid drainage	20 (6.0%)	9 (6.1%)	10 (6.9%)	39
Landforms not created to design standards	19 (5.7%)	10 (6.8%)	10 (6.9%)	39
Human access to relinquished mine site	18 (5.4%)	9 (6.1%)	11 (7.6%)	38
Extreme weather events	18 (5.4%)	11 (7.5%)	9 (6.2%)	38
Ecological communities do not develop	19 (5.7%)	10 (6.8%)	8 (5.5%)	37
Impacts on threatened flora and fauna	22 (6.6%)	8 (5.4%)	5 (3.4%)	35
Climate change effects (long term)	16 (4.8%)	6 (4.1%)	9 (6.2%)	31
Litigation over environmental or social outcomes	12 (3.6%)	4 (2.7%)	8 (5.5%)	24
Community expectations being too high	15 (4.5%)	5 (3.4%)	4 (2.8%)	24
Cumulative risks across the catchment	12 (3.6%)	8 (5.4%)	3 (2.1%)	23
Community changing their preferences	16 (4.8%)	5 (3.4%)	2 (1.4%)	23
Other	5 (1.5%)	3 (2.0%)	3 (2.1%)	11

4.3.7 Monitoring

Progress towards meeting completion criteria are typically evaluated by comparing outcomes against benchmarked analogue/reference sites, or by monitoring whether a system is moving towards a stable system (Appendix 4.5.2). The main considerations for mining industry and consultants when choosing a reference site are:

- Matching anticipated end land use
- Suitability to end land use
- Matching pre-existing vegetation at the mine site
- Proximity to the mine site
- Selection is based on what's achievable

Monitoring methods used by industry and consultants to assess progress towards completion criteria are listed below. These monitoring methods are (a) chosen to address specific completion criteria; (b) based on previous company experiences; and (c) chosen to detect early effectiveness of interventions (Appendix 4.5).

- Vegetation transects
- Ecosystem/Landscape Function Analysis
- Remote sensing
- Soil and/or water testing
- Erosion/landform stability plots

Other evaluation methods mentioned are permanent vegetation plots, fauna trapping, agricultural trials, visual inspections, or combinations of the above.

Frequency of monitoring is highly site-dependent, but typically occurs annually during the early stages of rehabilitation and then periodically at increasing intervals (e.g. 1, 2, 3, 5, 10, 20 years from rehabilitation completion).

Regulators were also asked what key items they would like to see in a monitoring program, and what is 'typical' in closure plans assessed (Table 4.9). Like industry and consultant responses, regulators want to see comparisons against benchmarked analogue/reference sites. Some items that regulators want to see in closure plans, but that are not always included, are details about the specific data to be collected, and details about the monitoring techniques to be used.

TABLE 4.9 Regulators' responses on monitoring programs
Number of times mentioned are provided with percentage of total provided in parentheses

	What key items do you want to see in a monitoring program? (Pick up to 4)	Which of these is/are typically included in monitoring programs?
Benchmarked against analogue/reference sites	9 (21%)	6 (17%)
The plan details what specific data will be collected	6 (14%)	3 (9%)
Monitoring plans are supported by risk assessments	5 (12%)	6 (17%)
Monitoring techniques are specified in the plans	5 (12%)	1 (3%)
The plan details a time schedule for data collection	5 (12%)	8 (23%)
The plan details how reference sites were chosen	4 (9%)	3 (9%)
Benchmarked against ISO or other standards	3 (7%)	–
Monitoring plans are developed in collaboration with independent scientists	3 (7%)	–
Monitoring is performed by independent consultants	1 (2%)	1 (3%)
Monitoring is performed at regular time intervals	–	5 (14%)
Other	2 (5%)	2 (6%)
Total number of answers provided	43	35

4.3.8 Engagement

All respondents were asked what key (other) regulator(s) (Table 4.10) and stakeholders (Table 4.11) were engaged/consulted with when developing/advising on mine closure plans. Although the EPA is part of DWER, the Pastoral Lands Board is part of DPLH, the Conservation and Parks Commission is part of DBCA, and the Pilbara Development Commission is part of DPIRD, these entities were presented separately to assess whether respondents engage differently with specific agencies. Nevertheless, from written comments to the survey, four respondents chose to answer for the overall relevant department rather than specific commissions/agencies.

Consistent across all stakeholders, the main regulators involved in the development of mine closure plans are the Department of Mines, Industry Regulation and Safety (DMIRS); the Department of Water and Environmental Regulation (DWER) and its incorporated Environmental Protection Agency (EPA); and the Department of Biodiversity, Conservation and Attractions (DBCA).

The Department of Jobs, Tourism, Science and Innovation (DJTSI) is involved only where State Agreement Act sites are concerned. Interesting is the relatively low engagement with the Pastoral Lands Board and the Department of Planning, Lands and Heritage (DPLH) given that (a) this Department is the ultimate custodian of all pastoral and Unallocated Crown Lands, and (b) 35 of the mining industry respondents identified pastoral as their anticipated post-mining land use. Also noteworthy is that mining industry respondents were the only ones to indicate that they engage directly with local governments. Surprisingly, there are four respondents who stated that they do not engage with any regulators (Table 4.10).

Mining industry and consultants were asked whether they have one or multiple points of contact with the regulator. The vast majority (72% of mining industry and 100% of consultants) stated that they liaise with different people. This means that advice provided by a regulator could vary depending on the contact person involved.

Finally, respondents commented on the community stakeholders involved when developing completion criteria. The majority of respondents communicate with traditional owners and neighbouring (agricultural) landholders, whilst a small portion of mining industry proponents (11%) and consultants (35%) stated that they do not engage with community stakeholders. A few mining respondents also mentioned shire councils and natural resource management (NRM) groups as relevant community stakeholders.

TABLE 4.10 Key regulator(s) engaged with when developing completion criteria / assessing mine closure plans

Number of times mentioned are provided with percentage of total per stakeholder group in parentheses

Key regulator(s) engaged (select as many as apply)	Mining industry	Consulting business	Regulators
DMIRS (Dept. Mines, Industry Regulation and Safety)	29 (23%)	16 (24%)	9 (19%)
DWER (Dept. Water and Environmental Regulation)	22 (18%)	9 (13%)	9 (19%)
↳ EPA (Environmental Protection Agency)	15 (12%)	9 (13%)	7 (15%)
DBCA (Dept. Biodiversity, Conservation, Attractions)	15 (12%)	9 (13%)	3 (6%)
↳ Conservation and Parks Commission	3 (2%)	1 (1%)	4 (9%)
DJTSI (Dept. Jobs, Tourism, Science, Innovation)	6 (5%)	5 (7%)	5 (11%)
DPLH (Dept. Planning, Lands, Heritage)	9 (7%)	2 (3%)	3 (6%)
↳ Pastoral Lands Board	1 (1%)	4 (6%)	2 (4%)
DPIRD (Dept. Primary Industries and Regional Development)	3 (2%)	2 (3%)	2 (4%)
↳ Pilbara Development Commission	–	1 (1%)	–
Local government	9 (7%)	1 (1%)	–
Forest Product Commission	4 (3%)	1 (1%)	1 (2%)
We don't engage with regulators	3 (2%)	1 (1%)	–
Water Corporation	1 (1%)	1 (1%)	–
DLGSCI (Dept. Local Government, Sport and Cultural Industries)	–	1 (1%)	–
Other	4 (3%)	4 (6%)	2 (4%)

TABLE 4.11 Key community stakeholder (s) engaged with when developing completion criteria / assessing mine closure plans

Key community stakeholders engaged	Times mentioned
Traditional owners/Native title group	22
Pastoralists/Agricultural landholders	20
Shire council/Local Government	15
Local community groups/NGOs	7
Catchment NRM groups	4
Other mining companies	3
Wildflower Society	2
Local businesses	2
Universities	2
Kings Park & Botanic Gardens	1

4.3.9 Resources

In the last two questions of the survey, respondents were asked about the resources (financial, knowledge, staff, practical skills etc.) needed to meet (industry), develop (consultants), or advise on (regulators) completion criteria (Table 4.12). The majority of the industry respondents stated that they have sufficient resources available, with a lack in staff being the primary constraint. Consultants typically mention a lack in biophysical or ecological data as a constraint. The majority of regulators stated that they lack adequate resources but did not provide further explanation.

Contrary to expectations, smaller mining companies (operating revenue less than \$100 million/yr) were significantly more likely to report having sufficient resources, compared to mid-size and large companies ($p < 0.1$). This contrasts with a widespread perception among closure professionals that small companies often lack the resources and knowledge to develop completion criteria to the level of detail and rigour required by the regulator. Thus, a question to be further explored would be whether small companies perceive having sufficient resources because, a) they are unaware of their unmet regulatory requirements, or b) because their mine closure plans are approved, despite their shortcomings.

TABLE 4.12 Respondents' assessment of resource availability to meet/develop/advise on mine completion criteria or mine closure plans

Number of times mentioned provided

Does your organization have sufficient resources to meet/develop/advise on mine completion criteria or mine closure plans?	Mining industry	Consulting business	Regulators
Yes we have sufficient resources	27	7	2
We lack staff	4	–	2
We lack knowledge/data	2	6	1
We lack financial resources	2	–	–
We lack practical skills	1	–	–
We lack guidance from regulator	–	2	–
We lack examples of successful mine closures	–	1	1
We don't have enough time available	–	–	2
We don't have sufficient resources available (no explanation)	2	1	6
Total number of answers provided	38	17	14

Industry members and consultants were also asked whether the current resources provided by the regulator(s) are sufficient to help the planning of completion criteria. About a third of respondents agreed that there is sufficient guidance available (Table 4.13). However, at least one-fifth of respondents stated that government departments lack consistent, knowledgeable staff to evaluate mine closure plans. One respondent commented that: *“Different people at [the Department] means revisiting the same conversations over and over again”*. There was also a call for guidelines and examples for developing completion criteria, and increased consistency in expectations across Government departments.

TABLE 4.13 Respondents' assessment of resource provided by the regulator(s) to help planning of completion criteria

Are the current resources provided by the regulator(s) sufficient to help your planning of completion criteria? (# of times mentioned)	Mining industry	Consulting
Yes, there is sufficient guidance available	13	6
We need access to consistent staff with the appropriate knowledge	7	4
We need guidelines for developing completion criteria	5	1
We need greater alignment between government departments	3	2
We need more realistic criteria expectations	2	2
We need faster response times to submissions	4	0
We need more policy guidance on mine relinquishment	3	0
We need defined examples of expectation and benchmarks	2	0
We need more sharing of rehab data	1	1
Total number of times mentioned	40	16

4.4 Conclusion

This is the first time that an industry-wide investigation has been conducted to capture and analyse multiple stakeholders' perspectives around the development of mine closure completion criteria. We conducted semi-structured, qualitative interviews with 26 participants and a survey of 75 respondents, both of which included mining industry proponents, consultants involved with developing mine closure plans or completion criteria, and government regulators who assess or provide input into mine closure plans and completion criteria.

While the sample was small given the volume of number of stakeholders involved in mine closure, interesting trends could be observed in the data. Results were comparable between the interviews and the survey. Industry proponents and consultants had very similar opinions. They often commented on the regulator as lacking capacity, knowledge and a consistent coordinated approach to mine closure. Indeed, response from most regulators also indicated that they lack sufficient resources to adequately develop guidance for mine completion criteria development. This report and framework presented is a response to the need for such guidance.

4.4.1 Messages for industry proponents and consultants

The primary mine closure roadblock is a lack in knowledge. Many respondents welcomed the development of a framework for developing mine completion criteria. This would provide clarity about the level of detail required in closure criteria, and examples of what is acceptable to regulators. Areas for industry to improve include:

1. Sufficient investment in financial and staff resources for rehabilitation and closure, not only towards the end of a mine's life-time, but right from the start (government respondents commented that *"There is insufficient internal (mining company) closure capability / resources as environmental management / compliance is seen as a cost rather than a key factor of social licence to operate"*; and that *"Miners see completion criteria and rehab as something to consider at the end or towards the end of a mine's life and thus don't consider it to be an integral part of the mine's life and the mining development plan"*).
2. Invest in improving science-based knowledge of what are achievable rehabilitation standards in WA. Collecting and sharing baseline monitoring data across industry will be important to understand the core components of successful rehabilitation (*"In WA we simply don't have the knowledge of what is actually possible and how long it will take"* (consultant); *"Lack of advanced rehabilitation in the region from which learnings can be taken to feed more achievable completion criteria"* (mining proponent)).

During interviews, concerns were expressed that smaller companies may (a) have limited resources (financial and staff) available, resulting in less capacity for research, and (b) lack an internal knowledge base to set realistic, measurable, completion criteria compared to the larger miners. However, the results of this survey do not provide evidence for this. In fact, smaller companies were more likely to agree that they have sufficient information and resources available to meet current completion criteria. They were also more likely to agree that the regulator imposes additional standards on previously approved criteria, which may be indicating that smaller miners engage less regularly with the regulator to negotiate on completion criteria.

Another concern (raised primarily by regulators and independent consultants) is a risk posed by divestment, as industry proponents plan to sell off their assets as a site nears its closure date. In such cases, proponents may sell off their liability by on-selling sites to (smaller) companies *"without the internal culture and commitment to achieve a good environmental outcome"*. There are opportunities for companies to build assurances around this issue, to increase regulators' trust and social licence to operate.

4.4.2 Messages for regulators

There were several recurring comments from proponents and consultants about challenges related to government policies and Departments' capacity to guide closure criteria. Indeed, most regulators agreed that they lack the adequate resources (knowledgeable staff and time) to guide the development of mine closure plans. Reflective of the background of the majority of respondents, there were more critical recommendations for regulators than for industry. Study results pointed at the need to:

1. Develop a consistent, coordinated approach to completion criteria across government departments, and ensure that the regulator who signs off on the ultimate liability for mines being relinquished to government is involved in the process (*"The mining proponent rarely negotiates with the ultimate custodial authority – DMIRS are not the custodial authority, they are only administering tenement conditions – the mining proponent needs to deal / negotiate with the custodial authority to achieve the needs of the ultimate land manager / owner"*).
2. Provide clear guidelines and examples ('direction') on what are acceptable completion criteria (*"The most important is a lack of understanding of an appropriate approach to working out what are the SMART criteria for all the relevant aspects for their site. I'm hoping that having a framework to help guide companies on the process and provide some examples of what works and what doesn't will help many companies improve their development of completion criteria"*).
3. Consider alternative PMLUs other than the pre-mining land use (where possible given legal constraints). One respondent stated that there is a *"Lack of ability for the regulator to think outside the box as to what the best end use for that particular parcel of land is post operations"*.
4. Set realistic standards that are achievable based on the current state of knowledge and suited to the life-stage of the mine (*"It is difficult if not impossible to match pre-existing ecosystem"*; *"A better awareness in DMIRS of achievable, cost-effective criteria"*).

Despite the challenges identified, there were also positive comments that demonstrated opportunities. There is already a lot of knowledge available at different companies, expert consultancies and within government agencies. There is a need to share this knowledge to bring together the available information around rehabilitation techniques, closure objectives and measurable completion criteria. The current project aims to do exactly this by developing a structural framework, based in science, industry feedback and case studies, to guide the development of completion criteria (Chapter 2).



4.5 Appendices

4.5.1 Sample characteristics

What was your company's approximate operating revenue in the 2016-17 financial year?	Mining industry	
	# resp.	%
< 1 million	3	7.5
1 – 9 million	3	7.5
10 – 49 million	3	7.5
50 – 99 million	2	5.0
100 – 499 million	4	10.0
500 – 999 million	1	2.5
1 – 5 billion	4	10.0
> 5 billion	9	22.5
Don't know	11	27.5
TOTAL	40	100

What is the approximate size of your company?	Consulting	
	# resp.	%
Large consulting business with offices in multiple (intern)national locations	5	27.8
Large consulting business with several offices in Western Australia	0	0.0
Small-medium consulting business with one office in Perth (or elsewhere in WA)	8	44.4
Sole trader	4	22.2
Other, namely	1	5.6
TOTAL	18	100

4.5.2 Monitoring

How do you typically evaluate progress towards completion criteria? (Tick as many as apply)	Mining industry		Consulting	
	# answers	%	# answers	%
Compare against benchmarked analogue/reference sites	25	42	15	40
Monitoring whether the system's trajectory is towards a stable system	24	41	15	40
ISO or other standards	5	8.5	2	5.3
No stated benchmark	3	5.1	0	0.0
Compare against agreed criteria/outcomes	1	1.7	3	7.9
Other	1	1.7	3	7.9
TOTAL	59	100	38	100

What evaluation/monitoring method(s) do you typically use to assess completion criteria?	Mining industry		Consulting	
	# answers	%	# answers	%
Vegetation transects	23	18	14	20
Ecosystem Function Analysis/ Landscape Function Analysis	19	15	11	16
Remote sensing	15	12	12	17
Soil and/or water testing	23	18	7	10
Erosion/landform stability plots	18	14	9	13
Permanent vegetation plots	15	12	7	10
Fauna trapping	9	7	2	3
Grazing / cropping trials	1	1	2	3
Other (visual monitoring, combination of methods, ...)	5	4	5	7
TOTAL	127	100	69	100

What are the main reasons for choosing that/those monitoring method(s)? (Pick up to three)	Mining industry		Consulting business	
	# answers	%	# answers	%
To address our specific completion criteria	26	30	12	29
Based on our previous experiences	18	21	10	24
To detect early effectiveness of interventions	15	17	8	19
To improve statistical efficiency	8	9	4	10
Based on referenced best practice	6	7	4	10
Based on external guidelines	8	9	0	0
Based on examples from other businesses	3	4	1	2
Other (e.g. based on approval processes)	1	1	3	7
Don't know	1	1	0	0
TOTAL	86	100	42	100

(END OF CHAPTER 4)