CRITIQUE OF THE

ENVIRONMENTAL REVIEW AND MANAGEMENT PROGRAMME

FOR THE

WEST ANGELAS PROJECT

April 1998

OVERALL COMMENTS

The ERMP document is only just satisfactory, lacking in many areas. It fails to address many issues in sufficient detail to permit an informed assessment of the environmental impacts of the project. The document appears to be more a self-justification exercise rather and an environmental review of the project and its options. Without access to the constituent consultant reports used to compile the ERMP the assessment task would have been severely impeded. The proponent is acknowledged for making the consultant's reports available for review.

There appears to have been problems with the process of drafting and submitting the ERMP document. Two issues are of particular concern. Firstly, the apparent finalisation, submission and release of the ERMP document prior to the completion of all consultants reports. How can the ERMP document accurately present the existing environmental attributes and how can commitments be made to manage impacts on the existing environment when all the data is not yet in? In particular, reference is made to the fauna treatment in the ERMP which was available prior to the consultants completing and submitting their report to the proponent. A similar discrepancy was evident for surface hydrological matters. The second issue of process relates to the disparity between the draft ERMP supplied to CALM for comment in late 1997 and details presented in the final ERMP. While it is acknowledged that some on the differences may be a result of improvements suggested by CALM and perhaps other reviewers, some of the changes are of concern to CALM. In particular, the change in the preferred rail option from the Mt Robinson route to the Coondewanna West route between the two versions of the ERMP document. What was the point of seeking CALM's comments when such major changes were made after the fact?

The failure of the ERMP document to consider the impacts of the project on other areas of conservation value, apart from the two National Parks, was disappointing. As the company are no doubt aware, the Coondewanna-Mt Robinson and West Angelas areas are both encompassed within a proposed 'Mulgalands' conservation reserve (Attachment 1). This proposal for a multiple-use

conservation reserve encompassing these areas has been active for over a decade (Dunlop and Porter 1985) having been given new impetuous in the past two years (van Leeuwen *et al.* 1998). The proponent should be aware of these conceptual land use plans having been briefed in the field (April 1997) and at a meeting convened by the Department of Resources Development (September 1997). Similarly, a draft copy of a report prepared by van Leeuwen *et al.* (1998) was also supplied to the proponent, along with maps outlining the reserve proposal. Similarly, the failure to recognise and discuss potential impacts of the Mt Leal and Georges River proposed rail routes on the planned land addition to the Millstream Chichester National Park south of Mt Leal (Fish Pool Block) was disappointing. This is despite the proponent's consultants being aware of the proposed addition (Trudgen and Casson, 1998, Vol. 1, pg. 148). It is acknowledged that the proponent was not requested to address issues related to these conservation reserve additions in the 'Specific guidelines for the preparation of the ERMP' as compiled by the EPA.

The Mt Robinson rail route option is credited to CALM in the ERMP (pg. 25). While this statement is accurate the route depicted in the ERMP and associated consultants reports is not a true reflection of the proposed CALM alignment, which was supplied to the proponent's consultant, *ecologia*, in April 1997. As depicted in Attachment 2, the CALM route did not cut directly across the Coondewanna Flats from near Packsaddle Hill but rather ran parallel to the Packsaddle Range east to the Great Northern Highway. At the highway the CALM proposed route turned south parallelling the highway until a point south of The Governor where it turned west across to the West Angelas Mine area. In turning west the CALM intention was for the this rail route to pick up the West Angelas Mine Access Road, as correctly depicted in map 324538-10 of Appendix B in the ERMP.

This CALM alignment was suggested in order to negate the Coondewanna West route and the deleterious impacts such a route would have on areas of very high conservation value, in particular, near pristine mulga woodlands and flora species of conservation significance. The deleterious impacts would be promoted by changes in surface hydrological patterns, modifications to the area's fire regime and potentially the introduction of environmental weeds. The CALM route was also suggested as it minimised the impacts on pastoral activities on the Coondewanna Flats, which is part of Juna Downs Station. In formulating the CALM proposed route, consideration was also given to issue of drainage management, which was a principal reason why the route did not directly cross the Coondewanna Flats but stayed on high ground at the foot of the Packsaddle Range. Similarly, consideration was also given to drainage management along the proposed route paralleling the Great Northern Highway, a road constructed with drainage management and minimisation of impacts as a very high consideration (Dames and Moore 1984). The rationale for placing the rail route parallel to the highway was to consolidate/concentrate impacts in a single corridor. The same rationale was used to justify placing the West Angelas Mine Access Road in CALM's proposed Mt Robinson rail route.

As the proponent's Mt Robinson route crosses the Coondewanna Flats it would be expected that some biotic assemblages on conservation significance would be encountered as the Flats are known to have high conservation value (van Leeuwen *et al.* 1998). Speculatively, these assemblages may not be encountered if the CALM proposed route was adhered too. The proponent should be encouraged to investigate the suitability of the actual CALM Mt Robinson route.

VEGETATION AND FLORA ISSUES (SECTIONS 5.7 TO 5.9)

General comments

The treatment of vegetation and flora for this project was adequate for the level of assessment, although a few gaps in the data are apparent. These gaps relate primarily to the information presented in the ERMP document and the failure to commission some investigations which would have assisted with the assessment process. The gaps do not relate to the quality and reliability of the botanical consultant's reports. Principal among these investigations not undertaken would be a botanical survey of the existing Hamersley Iron route in the vicinity of the Mt Leal and Georges River routes. It appears that the proponent has dismissed this route option on the grounds of financial considerations

alone (shorter distance) without any consideration of botanical (biological) resources and nature conservation values. The absence of botanical data for this route option hinders the botanical impact assessment, especially for comparisons between route options in the vicinity of and impinging on the Millstream-Chichester National Park.

The quality and rigour of the botanical investigations undertaken are among the best reviewed for a development project in the Pilbara. The botanical consultants efforts are exemplary and they should be commended for the quality of the work. Similarly, the proponent should be commended for commissioning such detailed and descriptive investigations. The level of liaison between the proponent, their botanical consultants and CALM, especially with respect to botanical survey design, species identification and the provision of survey results is exceptional and indicative of the developing rapport between the proponent and CALM.

Unfortunately, the efforts and the quality of the botanical consultants work is not reflected in the ERMP document as a consequence of clumsy compilation and editing of the botanical sections. In its simplest manifestations this incompetence is highlighted by the failure to cite in the ERMP's References (pages 173- 178) numerous references which were cited in the main body of the botanical text. Examples include: Atkins (1997); Beard (1980); Casson (1994); Garratt (1987); Griffin (1984); Hopper *et al.* (1990); Mattiske (1992); Mattiske and Associates (1992); Payne *et al.* (1988); Specht *et al.* (1974); Trudgen (1984); Weston and Trudgen (1997); and Weston and Trudgen and Casson (1998).

Another manifestation of this problem is the order in which "Regional assessments and conservation values based on Beard (1975)" have been transposed from the consultant's reports. The order in the ERMP differs from the consultant's document and thus the nomenclatural currency of some species names is confusing. For example, the consultant noted when first referring to Beard's (1975) vegetation descriptions that *Eucalyptus brevifolia* was now *E. leucophloia,* whereas there is no mention made of this nomenclature change when discussing Beard's vegetation descriptions in the ERMP.

Yet another manifestation of this problem was the failure of the ERMP to provide data on the botanical values of all project options and when given, was inconsistent in providing such detail. For example, the Georges River, Mt Herbert, Hamersley Station Flats Eight Mile Bore and Mt Robinson rail route options are excluded from the vegetation assessments provided in the ERMP. Table 1 provides a summary of these data provision inconsistencies. Such inconsistencies make the task of botanical impact assessment and evaluation all that more difficult and tedious.

It is assumed from the details provided in Table 1 that data on the borefield vegetation and flora was presented in a separate consultant's report which has not been supplied to CALM and is not cited in the ERMP's reference list. Perhaps documents cited as Weston and Trudgen and Casson (1998) and Weston and Trudgen (1997) in the ERMP (pg. 64) provide the relevant information.

It is also assumed that details on the vegetation and flora along the Marandoo (Central Pilbara Railway) corridor in Karijini National Park were sources from Mattiske and Associates (1992), again a document not cited in the ERMP's reference list. It is clear from differences in style and descriptive terminology that the Marandoo Corridor details have been provided by another consultant. These style and descriptive terminology differences are annoying and make the botanical section of the ERMP more cumbersome than necessary.

Without the relevant botanical consultants reports, Table 1 clearly indicates that the ERMP does not provided sufficient information to permit an adequate assessment of this project, particularly with respect to the various rail route options identified. How can the general public and other interested parties who do not have access to the relevant consultants reports properly assess this project and formulate an opinion when all the relevant data is not provided?

Table 1 Analysis of the availability of botanical data presented in botanical consultant's reports and the ERMP.

Study Area	Consultants reports		ERMP	
	Vegetation	Flora/Floristics	Vegetation	Flora/Floristics
West Angelas Survey Area	✓	✓	✓	✓
West Angelas Access Road	✓	✓	×	✓
Turee Creek (B) borefield	× ^	×	✓	✓
Gas pipeline route	✓	✓	✓	✓
Railway routes				
Coondewanna West	✓	✓	✓	✓
Mt Robinson	✓	✓	×	×
Marandoo (Central Pilbara Railway) Corridor	×	×	✓	✓
Hamersley Station Flats, Four Corners Bore	✓	✓	✓	✓
Hamersley Station Flats, Eight Mile Bore	✓	✓	×	×
Mt Leal	✓	✓	✓	✓
Hamersley Iron Parallel (Western)	✓	✓	✓	✓
Mt Herbert	✓	✓	×	×
George River	✓	✓	×	×
Existing Hamersley Iron	×	×	×	×

Note: A Vegetation maps supplied (Trudgen and Casson 1998, Vol. 6) but not descriptive data.

Specific Vegetation and Flora comments

The consultants have provided a very detailed and informative account of the vegetation and flora in the project area and along the various rail route options. Their assessments of the conservation significance and nature conservation values of this biota were commendable and rational They were based on reviews of available data, a comprehensive understanding on how and what variables influence the partitioning of the Pilbara biota at a regional and local scale and a comprehension of the processes which impinge on nature conservation values in the region (eg. weeds, stock grazing, fire).

Details on the botanical significance of the West Angelas area, especially floristic richness when compared to similar areas in the Pilbara (Table 5.2, pg. 76) were commendable, especially with the plausible explanations for the patterns of floristic richness observed. Similarly, details on the richness of vegetation associations in the West Angelas area and its subsequent nature conservation significance were agreeable. Explanations for both floristic and vegetation association richness in the West Angelas area provided by the consultants comply with CALM's comprehension of the area's values.

Unfortunately, the information reported by the consultant was not always reproduced in the ERMP in a manner which was easily interpretable. This was especially true for assessments of the botanical significance of the various rail route options, as details were either obscured in the text or absent. Perhaps this botanical data could have been more readily disseminated in a tabular format which would have permitted ready comparisons between study areas, although as previously mentioned, the botanical valves for all study areas were not always provided in the ERMP despite most being available in the consultant's reports (see Table 1). In an effort to facilitate such comparisons Table 2 has been constructed using the ERMP and consultant's reports (Trudgen and Casson 1998, Weston 1997). This table principally attempts to summarise the botanical attributes of each rail route option.

- **Comparison between Rail Route Options: Coondewanna West *vs* Mt Robinson**

  Comparisons between the two rail route options to the east of the Karijini National Park suggest that the Coondewanna West option will have the greatest impact on vegetation associations, especially associations which were not recorded elsewhere during the botanical survey

Table 2 Botanical comparisons between the various route options for a railway between Cape Lambert and West Angelas.

	Rail route options							
	Coondewanna West	Mt Robinson	Hamersley Station Flats, Four Corners Bore	Hamersley Station Flats, Eight Mile Bore	Mt Leal	Hamersley Iron Parallel (Western)	Mt Herbert	George River
				Vegetation Associations				
No. of vegetation associations	44	23	21	13	40	23	38	41
No. of unique vegetation associations	29	14	14 (?)	6	19	6	13	23
No. of vegetation associations of high conservation value [A]	1	3	1	1	2	-	-	3
No. of vegetation associations of moderate conservation value [A]	-	1	-	-	2	2	1	2
				Flora				
No. of plant species	332	425	332	114	335	315	317	434
No. of Priority Flora Species (populations)	3 (3)	3 (6)	2 (5)	1 (?)	6 (16)	4 (27)	5 (15)	6 (55)
No. of plant species of conservation significance (populations) [A]	13 (21)	19 (35)	8 (13)	4 (11)	19 (60)	15 (38)	20 (63)	26 (105)

Note: A Conservation value and significance based on assessments by Trudgen and Casson (1998, Vol 1, Sections 6 & 7).

programme. This is exemplified by the fact that 66% of the 44 associations encountered along the Coondewanna West route were restricted to it, while along the Mt Robinson route, the number of restricted associations represented 60% of the 23 associations encountered. Clearly, the Coondewanna West route has high conservation value from a vegetation diversity stance, a point noted in the ERMP (pg. 66). The greater diversity of vegetation associations along the Coondewanna West route was recorded despite this route being shorter than the Mt Robinson route, a result which implies that the former route had a more heterogeneous collection of habitats. As noted in the ERMP (pg. 66) many of the associations along the Coondewanna West route were dominated by Mulga, *Acacia aneura*.

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  Vegetation associations of specific conservation significance were most abundant along the Mt Robinson route (Table 2). Trudgen and Casson (1998, Vol. 1, pg. 173) considered that this route had very high conservation value because of the presence of such associations, particularly claypan type associations, which were considered to be very uncommon on a regional scale. CALM concurs with this assessment of claypan vegetation associations around the Coondewanna Flats, particularly those adjacent to Lake Robinson.

  Floristically the Coondewanna West route appears to be lacking plant species and populations of species of conservation significance in comparison to the Mt Robinson route, a result which was attributed correctly to the greater diversity of habitats associated with the seasonal wetlands adjacent to Lake Robinson (Trudgen and Casson 1998). The Mt Robinson route is also 7.5 km (25%) longer which significantly increases the amount of land sampled and the opportunity to intersect additional habitats and thus plant species of conservation significance.

  Both routes had equal numbers of Priority Flora with one taxon common to both (*Goodenia stellata* P2). This taxon together with the remaining four Priority species are not particularly rare and are perhaps best categorised as poorly known (*Olearia fluvialis, Indigofera gilesii*) or in need of reappraisal to accurately reflect their conservation status (*Brachychiton acuminatus, Eucalyptus pilbarensis*). The impact of either route on the status of the five Priority species would appear to be negligible.

  With regards to the other species of interested identified along both alignments (Trudgen and Casson 1998, Vol. 1, pg. 123, 125) most of the 25 taxa have also been recorded from locations outside the proposed routes. Indeed, seven of the other taxa of conservation interest are common to both routes. The exception was two taxa which appear to be novel, not having been recognised in the scientific literature prior to this botanical survey. Both taxa (*Hibiscus* aff. *sturtii* (site 1209), *Tephrosia* aff. *densa* (MET 16150) were recorded along the Mt Robinson route. As the taxonomic status of these taxa is uncertain an accurate assessment of the impacts of this project on their conservation status is not practicable. Trudgen and Casson (1998, Vol. 1, pg. 37) note that it is unlikely that rail construction will impact on the population of *Tephrosia* aff. *densa* (MET 16150).

Vegetative difference between the two routes appeared to be considerable. Both have unique vegetation associations and associations not identified along the other. Both have high to very high conservation value in terms of these associations, the Coondewanna West route because of the greater diversity of unique associations and the Mt Robinson route because of the presence of several regionally uncommon associations. The floristic differences between the two routes appear to be negligible in terms of conservation values. This is especially true if the impacts on significant flora populations are mitigated through appropriate planning during construction as implied in the ERMP (pg. 75, 129).

Given the lack of clear distinction between both routes on botanical grounds it is perhaps worth considering the likely impacts of the rail on the associations encountered along each route. The greatest impact will be from changes in surface hydrology, especially modifications to the pattern of surface flows. As noted in the ERMP (pg. 25) modification to surface hydrology will be 'Severe' along the Coondewanna West route and 'Medium' along the Mt Robinson route. As the Coondewanna West route is dominated by associations characterised by Mulga, a species (and association) intrinsically reliant on unimpeded surface flows (acknowledged in ERMP, pg. 127, 128) it is likely that the impacts of the Coondewanna West route will be substantial on the vegetation associations present. The 'Medium' assessment from impacts of the Mt Robinson route on surface hydrology was considered to be a conservative appraisal by CALM given the extensive overland sheet flows previously observed along sections of this route (van Leeuwen and Start, personal observation). Whatever the likely impacts on surface hydrology of the Mt Robinson route it is likely that the impacts on the vegetation associations present will also be substantial, especially given the predominance of associations characterised by Mulga.

Once again no clear distinction between the routes is apparent based on likely impacts, although these impacts need to be considered with reference to the existing state of the environment, current levels of degradation and the compounding affects such impacts may have on the environment. As discussed previously, CALM's Mt Robinson route, was suggested as a alternative to avoid sensitive mulga associations on gentle relief and to consolidate/confine impacts to a single corridor. Any adverse impacts of a new railway adjacent to the Great Northern Highway, especially on surface hydrology in mulga associations on gentle slopes would added to those impacts already manifested as a result of the highway. Similarly, aligning the West Angelas Access Road with the southern portion of the Mt Robinson route would also confine any impacts to a single corridor, especially impacts on the mulga associations which are abundant along this route (Trudgen and Casson 1998, Vol. 1, pg. 189). The other principal reason why CALM's Mt Robinson route was proposed was because vegetation associations along this route were already somewhat degraded (Fox 1983, Shaw 1995a, 1995b) as a consequence of stock grazing and other pastoral management activities, as this route is on Juna Downs Station.

Conversely, the Coondewanna West route would impact on many vegetation associations which are in near pristine state. This route traverses mulga woodlands which have not been intensively grazed or ravaged by pastoral burning practices having only been impacted by minor exploration tracks. The integrity and conservation value of the mulga woodlands along this route has been acknowledged for many years as demonstrated by numerous authorities (Dunlop and Porter 1985, CALM 1989, 1995, EPA 1992, Fox and Dunlop 1983, Fox 1983, Fox and Carey 1985, van Leeuwen *et al.* 1998) who have recommended the addition of the woodlands to the conservation estate. In the report by Dunlop and Porter (1985), which was commissioned by the former National Park Authority and the Department of Conservation and Environment, the majority of the Coondewanna West route falls within a region proposed as a Management Priority Area. Management Priority Areas were identified as areas requiring special management to maintain their conservation values. The authors (Dunlop and Porter 1985) identified impediments to surface drainage from the inappropriate construction and orientation of infrastructure corridors as paramount among the potential impacts which would require special attention. Part of this Coondewanna West route also falls within a region designated by Dunlop and Porter (1985) as a

Scientific Reference Area. These areas were proposed as references sites to monitor long term temporal changes in ecological patterns and processes, especially with respect to mulga woodlands. Dunlop and Porter (1985) also proposed that the Scientific Reference Area be added to the Karijini National Park.

Over the past 2 years, proposals for the creation of a 'Mulgalands' conservation reserve (van Leeuwen *et al.* 1998) have built upon the work of Dunlop and Porter (1985). Under the current reserve proposals the majority of the Coondewanna West route is within the proposed conservation reserve while approximately 50% of the Mt Robinson route is also captured (Attachment 1). While the intentions of the current reserve proposals are to operate and function cooperatively and in harmony with development through the auspices of a multiple-use bipartisan land management protocol, it has always been CALM's intent to seek the protection of biological assets with high conservation value. The mulga woodlands along the Coondewanna West route are one such asset.

Such mulga woodlands, particularly those on gentle slopes which are common along the Coondewanna West route have recently been recommended for addition to the inventory of Threatened Ecological Communities in Western Australia (Val English, Threatened Species and Communities Unit, CALM, personal communication).

In summary, both route options have similar botanical values and are likely to be impacted to a comparable extent by the proposed development of a railway. Given the current standing of the environment along both routes, previous degradation history, the likely severity of impacts on pristine habitats and previously recognised conservation values it appears that the Coondewanna West route is the least acceptable. Therefore, the proponent should be encouraged to pursue the Mt Robinson route with the modification previously discussed.

- **Comparison between Rail Route Options: Hamersley Station Flats, Four Corners *vs* Eight Mile Bore**

  Direct comparisons between the Hamersley Station Flats Four Corners Bore and the Eight Mile Bore route proposals are not possible as the routes differ substantially in length (45 km vs 30 km, respectively) and consequently the former encounters an extensive number of habitats not found in the latter. Also, a direct comparison is not appropriate for this evaluation as sections of the Four Corners route are integral to the Eight Mile Bore route, should it be selected. The comparisons undertaken within were only conducted for those sections of the two routes which are direct alternative options, ie. from directly south of the Mt Sheila Road to the Central Pilbara Railway corridor, 19 km west of Marandoo.

  From an interrogation of vegetation mapping data provided in Trudgen and Casson (1998, Vol. 6) the greatest diversity of vegetation associations was detected along the Eight Mile Bore route. Along this route there were 20 vegetation associations identified while along the alternative Four Corners Bore route there were 14. Six vegetation associations along the former route were not recorder in the latter while all in the latter route were present along the former. The Four Corners Bore route has one association of moderate to high conservation significance while the Eight Mile Bore Route has two. Vegetation association 6adb4 (*Themeda* sp. Hamersley Station (MET 11431) tussock grassland) was identified as one of the associations of conservation significance. This association was recorded along both route options but was most abundant along the Eight Mile Bore route where it covers approximately 14 km of the alignment. Along the alternative route this vegetation association covers only 9 km. The other association of conservation significance recorded along the Eight Mile Bore route was association 5m (*Grevillea berryana* woodland over *Eriachne mucronata* grassland) which occupied only a few hectares.

  Floristically, it was not possible from the data provided to identify differences in the species richness of the two alternative routes. However, it was possible to identify those species of conservation significance. Both routes contained one Priority Flora species and a number of

other species of conservation significance (Trudgen and Casson 1998, Vol. 1, pg. 128, 130). Both species (*Themeda* sp. Hamersley Station (MET 11431), *Glycine falcata*) of conservation significance encountered along the Four Corners Bore route were also recorded from the Eight Mile Bore route. Along the Eight Mile Bore route two additional species (*Boerhavia paludosa, Desmodium campylocaulon*) of significance were recorded. The *Desmodium* is the most significant, being represented by only three known populations in Western Australia, two of which are along the Eight Mile Bore route.

On vegetation association and floristic considerations it appears that the proponent's preferred option, the Four Corners Bore route, will have the least impact, especially on conservation significance vegetation associations and plant species. The conservation significance of these Hamersley Homestead Plains grassland communities has previously been recognised (S. van Leeuwen and A. Start, personal observation) and they are currently under consideration for inclusion on the list of Threatened Ecological Communities in Western Australia (Val English, Threatened Species and Community Unit, CALM, personal communication). CALM therefore would support the route which minimised disturbance and the potential for deleterious impacts on the significant communities of the Hamersley Homestead Plains. Since the Four Corners Bore route has the least impact on surface hydrology (ERMP pg. 24), which would inherently be of considerable importance in these cracking clay grasslands, the proponent's preference for the Four Corners Bore route is acceptable.

- **Comparison between Rail Route Options: Millstream Chichester National Park routes**

  Comparisons between the botanical significance of the various rail route options in the vicinity of and through the Millstream Chichester National Park was a difficult task. Complications arose because of the failure of the proponent to provide details on all routes in the ERMP, in particular the Georges River and existing Hamersley Iron routes. It appears that botanical investigations have not been undertaken along the existing Hamersley Iron route as details of such surveys were not even provided in the various consultant's reports. How can the impact of each route on the biota be assessed if all the data is not available?

  Comparisons are possible between the Mt Herbert and Hamersley Parallel West route which are alternative options. However, no comparisons are possible for the Mt Leal route. It appears therefore that the proponent's preferred route in the Millstream Chichester National Park area has been selected through considerations which have not included an assessment of the existing environment and the potential impacts on the environment that the route may have. This deficient route selection process is acknowledged by the proponent in the ERMP (pg. 24).

  It is acknowledged that some details are provided on the Georges River route in the ERMP, including the proponent's justifications for its rejection (pg. 21, 22). On botanical grounds, especially with respect to the number of unique vegetation associations, vegetation associations of conservation significance and flora species of conservation significance (Table 2), the proponent's rejection of the Georges River route was justified.

  * **Comparison between Rail Route Options: Mt Leal *vs* Existing Hamersley Iron route**

  Botanically the Mt Leal route appears to have moderate to high conservation value. The route contains a number of vegetation associations and plant species of conservation significance, predominantly because the associations and species are poorly known, rare or restricted to the cracking clay soils and damp habitats present along this route. The botanical significance of the route is enhanced by the high vegetation association and floral diversity reported (Trudgen and Casson 1998, Vol. 1, pg. 132, 152), the abundance of unique vegetation associations not encountered elsewhere during the survey (even along the Georges River route which traverses similar terrain in close proximity) and the number of edaphically restricted species encountered. The pristine character of the environment along this route, as exemplified by the absence from all but one sample site of the environmental weed Buffel Grass (*Cenchrus ciliaris*), also enhances the route's conservation status. Subjectively, this route appears to have a considerably higher

conservation value than the existing Hamersley Iron route, if only for the fact that along the existing route there are numerous populations of Buffel Grass and other environmental weeds (eg. *Acetosa vesicarius*, Ruby Dock).

CALM also suggests that the botanical conservation values of the Mt Leal route are considerably higher than the existing Hamersley Iron route as the latter only traverses approximately 7 km of cracking clay terrain, the terrain which contains the majority of vegetation associations and flora species of significance identified along the Mt Leal route. Conversely, the Mt Leal route traverses approximately 14 km of cracking clay terrain from the Wittenoom-Roebourne Road to just south of Mt Leal on Narrina Creek. These Chichester Range cracking clay communities have been proposed for addition to the inventory of Threatened Ecological Communities as they are not well represented on the conservation estate and are extensively grazed elsewhere on the Chichester Plateau (Val English, Threatened Species and Community Unit, CALM, personal communication). The potential environmental impacts of the rail development on the botanical conservation values of the existing Hamersley Iron route are also considered to be less than the Mt Leal route as the former has already been impacted by such a development and any further impacts are likely to be negligible in comparison to the disturbance of pristine vegetation associations.

The proponent has selected the Mt Leal route as the preferred route based on financial and capital cost considerations associated with hydrological problems and the presence of collapsing soils (presumably cracking clays) (ERMP, pg. 23, 24, Table 2.4). These justifications are made with disregard for environmental considerations and do not appear logical. Firstly, if cracking clay soils are a problem for rail construction then the shortest route through such terrain should be the most favourable. As already discussed, the shortest route through cracking clay terrain is along the existing Hamersley Iron route. Secondly, the proponent assesses the affects on surface hydrology as 'Severe' along the existing Hamersley Iron route and 'Medium' along the Mt Leal route (ERMP, Table 2.4) but surely these assessments are *vice versa*. How can the affects on surface hydrology be 'Severe' when the route parallels the existing Hamersley Iron line where the surface hydrology has already been impacted and environmental change has occurred? Surely the impacts on surface drainage of another structure parallel to the existing Hamersley Iron line would be negligible and if any, would only compound impacts already evident. The environmental consequences of such a route selection are undoubtedly less than the selection of a route through pristine terrain where the environment has not previously been degraded.

The proponent also cites the availability of construction material and moderation in construction restrictions as reasons why the Mt Leal route was selected as the preferred option. The proponent seems to have ignored the fact that the Mt Leal route travels through a National Park and proposed addition to it (Fish Pool Block). Inherently, such a land tenure classification will place restrictions on construction activities and limit the proponent's ability to readily source construction material. Accordingly, CALM would undoubtedly be more receptive to construction activities which restrict impacts to a single corridor through the National Park which is conferred by a route parallelling the existing Hamersley Iron line. As this Hamersley Iron line is along the boundary of the existing National Park and proposed Park addition for the majority of its traverse, the extent of restrictions on both construction activities and the availability of construction materials are likely to be less.

In summary, the Mt Leal route is not acceptable on botanical and potential environmental impact grounds. The Mt Leal route has high conservation value as it contains vegetation associations and plant species which are of conservation significance. The route is also in a pristine environmental state. Impacts of a railway on the environment along this route are likely to by considerable. The proponent should be encouraged to use a route which parallels the existing Hamersley Iron line, thereby confining impacts to a smaller area and mitigating the extent of any impact as the environment along such an alignment has already been altered. The selection of the existing Hamersley Iron route however, should only occur after a full biological investigation and

assessment. Authoritative comparisons between these two possible routes can then be undertaken. Such an assessment should be mandatory for environmental approval.

* **Comparison between Rail Route Options: Mt Herbert vs Hamersley Parallel West Route**

Botanical comparisons between these two routes are possible with reference to the report by Trudgen and Casson (1998), although ambiguous wording in the ERMP (pg. 23) makes it unclear if the details presented in Trudgen and Casson (1998) are in fact for the preferred alignment selected along the Hamersley Parallel West route. A comparison between the route maps in Trudgen and Casson (1998, Vol. 6) and as presented in the ERMP (Figure 2.2 and Appendix B) were inconclusive due to differences in scale. If the route selected by the proponent differs from that discussed by Trudgen and Casson (1998) then further survey work is inherently warranted. An assessment of the botanical values of the various options and the likely environmental impacts is not possible without such information.

Assuming the Hamersley Parallel West route investigated by the proponent's consultants is the preferred route detailed in the ERMP then it appears acceptable on botanical grounds. The vegetation associations along this route were less diverse than on the Mt Herbert route and tended to be recorded from other localities during the survey, especially the Mt Herbert and George River routes. Those associations which were unique to the Hamersley Parallel West route (eg. 2b, 2ecla, 2ecld) were of limited conservation significance as they were not considered to differ greatly from the general range of variation expected throughout the Chichester Plateau (Trudgen and Casson 1998).

The floristic diversity of both alignments was similar, as was conservation significance with respect to species of conservation and scientific interest (Table 2). Only eight of the 19 species of significance identified along the Hamersley Parallel West route were not recorded along the Mt Herbert route while all but three species were recorded from other sites during the survey. Two of these three significant species (*Hibiscus* aff *platychlamys* (site 1139), *Acacia* sp. (site 1149)) are known from other localities in the Pilbara. The remaining taxon (*Acacia* aff. *morrisonii* (site 1117)) is unlikely to be adversely affected by the railway as the population is distant from the proposed alignment (Trudgen and Casson 1998, Vol. 1, pg. 39). In comparison, 15 of the 25 species of conservation significance along the Mt Herbert route were not recorded from the Hamersley Parallel West route. Four of these 15 species of conservation significance were only recorded from the Mt Herbert route during the survey. One species (*Kennedia* sp. Barowanna Hill (MET 15617)) is of concern and will need to be considered in future development and management activities associated with this project regardless of the route which is eventually selected as the preferred option. This taxon was recorded from only one survey site (423) which was common to both route options.

In summary, the proponent's selection of the Hamersley Parallel West route as the preferred option, based on capital costs and financial considerations, is supported on the grounds of botanical considerations.

- **West Angelas Survey Area, Access Road and Gas Pipeline route**

Within the mine area and associated infrastructure corridors numerous vegetation associations were identified. The diversity of associations confers considerable conservation value on the West Angelas area as acknowledged by the proponent in the ERMP (pg. 62). The conservation value of the West Angelas area has been previously recognised and is a principal reason why the area has been proposed for addition to the conservation estate, as discussed above.

Numerous vegetation associations of conservation and biological significance were identified in the West Angelas area. The impacts on these associations of the proposed development varies from minimal to extensive, although in most instances no associations appear to be threatened with extinction as a result of the development. However, as noted by the botanical consultants (Trudgen and Casson 1998, Weston 1997) some associations require special attention to

minimise any deleterious impacts. Generally these associations appear to be dominated by Mulga and thus the proponent will need to minimise the impact associated with surface hydrological considerations and changes in fire regime. The importance of Mulga in the West Angelas area was highlighted by the botanical consultants (Trudgen and Casson 1998, Vol 1, pg. 180, Appendix Three). This taxon contributed significantly to the diversity of vegetation associations identified in the area. The significance of Mulga in this part of the Pilbara was known previously (Dunlop and Porter 1985) and is a fundamental contributing factor to CALM's desire to add the area to the conservation estate (van Leeuwen *e. al.* 1998).

Particular attention will need to be directed at minimising the impacts of the development on the cracking clay communities in the West Angelas valley. These communities were identified as significant by the botanical consultants (Trudgen and Casson 1998, Vol 1, pg. 185) based on the uniqueness of the vegetation association and the plant species which constituted them. Many of these species were of conservation and scientific interest (Trudgen and Casson, 1998, Vol. 1, pg. 114). CALM had previously recognised the cracking clay communities in the West Angelas area as having significant conservation value (van Leeuwen *et al.* 1998). These communities have been recommended for inclusion on the inventory of Threatened Ecological Communities as a consequence of their rarity and the deleterious impacts that grazing and weed invasion can have on their integrity (Val English, Threatened Species and Community Unit, CALM, personal communication). The significance of these communities is acknowledged in the ERMP (pg. 80) with the proponent mentioning that impacts should be minimal. The proponent should be encouraged to make a commitment to ensure that the impacts on this community are negligible. Such a commitment would inherently imply the isolation of such areas from disturbance and ensure the implementation of management protocols which prevent the introduction of environmental weeds.

An association characterised by Mulga over Chenopodiaceous shrubs and hummock grasses (6adb25, site 892A) also appears to be of considerable conservation significance. As this association appears to be uncommon in the region it may require special management to limit any deleterious impacts. This is especially true as the association was recorded from an area common to both the Coondewanna West and Mt Robinson rail route options and the West Angelas Survey Area. As the association was dominated by Mulga it is likely that surface hydrological considerations will be important in the mitigation of impacts.

Numerous species of conservation and scientific significance were identified in the West Angelas area. As many of these species were recorded from the cracking clay communities, management protocols to protect such communities, as suggested above, should also ensure the protection of the constituent flora. The management of other species of conservation and scientific significance may be achieved by the appropriate protocols implemented via the EMP, as acknowledged in the ERMP (pg. 129).

- **Central Pilbara (Marandoo) Railway Corridor**

  No separate botanical assessment was undertaken along the alignment of the proposed railway route which parallels the Central Pilbara (Marandoo) Railway through the Karijini National Park and west to a point approximately 19 km from Marandoo.

  While it is acknowledged that the details of such a botanical assessment did not need to be as rigorous as for those new potential routes proposed by the proponent, some type of impact assessment was warranted, especially for communities and plant species of conservation significance. Mattiske and Associates (1992) recorded a number of conservation significant communities and species along the Central Pilbara (Marandoo) Railway corridor. It is acknowledged that impacts on the significant communities may not be great as they have already been affected by the existing railway, however, what will be the impacts of the new railway be on conservation significant species and their populations, particularly in instances of rare and/or Priority flora?

The proponent should undertake and report on such an assessment as a prerequisite for environmental approval.

- **Rehabilitation**

  Little attention is given to rehabilitation and revegetation in the ERMP. It is acknowledged that the EMP is probably the more appropriate forum for such information.

  The incorporation of species of conservation and scientific significance into revegetation programmes is commendable (ERMP, pg. 129).

  The proponent should be encouraged to use provenance (locally collected) seed in all rehabilitation programmes. Hopefully, this will be addressed in the EMP, although a commitment to this issue in the ERMP would be applauded.

- **Environmental Weeds**

  Insufficient attention was given in the ERMP to the issue of environmental weeds.

  The two environmental weeds of greatest concern are Ruby Dock and Buffel Grass. Both will undoubtedly have numerous opportunities to impinge and impact on new locations and habitats through this development if quarantine and environmental hygiene protocols are not efficient and rigorously adhered to. This is especially true during construction when there will be large numbers of machinery movements and copious areas of ground being disturbed.

  Environmental weeds can significantly erode the conservation values of an area by impacting on communities of significant vegetation and flora. This is particularly true for areas in near pristine condition such as along the Mt Leal and Coondewanna West rail route options and for areas within or adjacent to the existing National Parks. Similarly, weed invasion of botanically significant cracking clay communities in the West Angelas valley would also be unacceptable. It is imperative that the proponent limits the opportunity for environmental weeds to have an impact on such communities and commits to control programmes if they do become established. Ideally this approach to environmental weeds should operate across all developments associated with this project.

  The proponent mentions in the ERMP (pg. 126) that a Weed Management Programme similar to the one in place at their Pannawonica operations will be developed for the West Angelas project. As this Pannawonica programme has been very successful at controlling environmental weeds, especially Ruby Dock, this approach is probably acceptable. Modifications to the Pannawonica programme will be necessary however, to take into account differences in biological and environmental conditions and the greater conservation significance of the West Angelas area. Modifications will also need to take into account differences in possible land tenure issues with respect to the potential for the West Angelas area being included in a multiple use conservation reserve while the Pannawonica area is on pastoral land. The West Angelas programme should have a very strong emphasis on prevention and hygiene thereby restricting the opportunity for environmental weeds to be introduced.

  The proponent notes that the control of weeds along the railway route will be covered by the Weed Management Programme (ERMP, pg. 127). This undertaking is not comforting as environmental weeds, particularly Ruby Dock, are prevalent along the existing railway to Pannawonica, especially in the Millstream Chichester National Park. At present it appears that the Pannawonica Weed Management Programme and the enthusiasm with which it has been implemented does not extend to weed management along the existing railway line. This issue is of great concern to CALM, especially if new rail routes through the Millstream Chichester National Park (Mt Leal) and areas of high conservation value (Coondewanna West) are developed. The proponent should demonstrate a commitment to the issue of environmental

weeds and their control along the proposed railway route by attending to environmental weeds along the existing railway.

The importance of environmental weeds in terms of their potential impacts, especially on the conservation estate, significant conservation values and pristine habitats warrants the production of a separate Weed Management Plan, which is distinct from the project's overall EMP. The proponent should be encouraged to produce such a document as a prerequisite to environmental approval.

Mitigation of existing environmental weed problems and demonstration of a genuine commitment to managing such impacts along any new rail route impinging on areas of conservation value, including the National Parks, can be achieved by closer liaison with CALM. This closer liaison may be promoted by a Memorandum of Understanding between the proponent and CALM. The Memorandum of Understanding would deal with management and operational issues which arise as a result of this project and affect either the proponent, their operations, the conservation estate or areas for which CALM has delegated responsibility.

- **Monitoring Sites**

  The ERMP (pg. 58) mentions that a number of vegetation survey sites have been established permanently for the intent of future monitoring. What will these sites be used to monitor, what hypotheses will be investigated and what is the experimental design of the monitoring programme(s)? These are all critical questions which need to be addressed prior to the establishment of any monitoring programme. It is imperative that the monitoring programme be designed with an understating of objectives and aims or subsequently any results will be meaningless and irrelevant to the conditions being monitored.

  The proponent should provide detailed information (objectives, aims, methodology) on the monitoring programme(s) which utilises these vegetation sites in the EMP.

- **Vegetation Maps**

  The vegetation maps supplied with the ERMP in Appendix C are too small. Details on the maps such as text, vegetation association codes and survey site numbers are not legible. Similarly vegetation association details and descriptions provided in the map legends are unusable as the code reproduced on the maps are not provided. When codes are provided, as in the two minesite maps, they bear no resemblance to the vegetation codes used on the actual vegetation maps themselves. There is no way of relating an association description to an area on the vegetation maps as the keys/codes are missing.

OTHER ISSUES

- **Surface Hydrology and Drainage Management**

  The potential for changes in surface hydrological patterns to impact on the environment as a consequence of this project are considerable and of immense concern to CALM. This is principally because of the extensive areas of conservation significant mulga woodlands on gentle slopes which are located in the vicinity of West Angelas and along the various rail route options through the Hamersley Range, especially the Coondewanna West route option. Consequently, changes in surface hydrological patterns have the potential to severely impinge upon significant nature conservation values, an impact which must be moderated.

  The proponent acknowledges surface hydrological problems and the potential for impacts on mulga woodlands (ERMP, pg. 25, 127) but does not adequately address how these impacts will be mitigated and what remedial actions will be taken to alleviate deleterious predicaments. The proponent states that the management of such impacts is an issue which can be dealt with by appropriate drainage structures and culverting. While this is a comforting assurance, how

practicable is it in reality? As Main Roads Western Australia and Hamersley Iron will undoubtedly affirm, with respect to the Great Northern Highway and the Central Pilbara Railway respectively, the management of such impacts is an extremely difficult and tedious undertaking. Hamersley Iron acknowledges that there will be a major impact on mulga woodlands immediately adjacent to the Marandoo to Yandicoogina section of the Central Pilbara Railway as a consequence of difficulties in interpreting the patterns of surface flow and designing suitable drainage management structures which permit the passage of water over/under the railway and redistribute it down slope (Jim Stoddart Hamersley Iron, personal communication). In general, the mulga woodlands which Hamersley Iron will impact are on steeper slopes with more clearly defined drainage than those in the Coondewanna and West Angelas areas which will be affected by the development.

The significant role of surface hydrology in the functioning and persistence of the conservation significant mulga woodlands of the Coondewanna and West Angelas areas and the considerable potential for deleterious impacts arising from this project demand the compilation of a detailed and meticulously designed Drainage Management Plan. This plan should address all issues of surface drainage management associated with this project, particularly those related to the railway line and activities which impact on mulga woodlands. This plan should include the pre-construction commissioning of detailed engineering, topographic and hydrological assessments along the railway route, especially in areas impacting upon mulga woodlands or other vegetation associations of conservation significance (cracking clay communities). Such an assessment should identify areas most susceptible to impacts and provide the proponent with solutions for their mitigation. Such an assessment should not only be confined to the railway route but should also include major infrastructure corridors in the mine area, including the West Angelas Access Road.

The Drainage Management Plan should also include comprehensive details on the monitoring programmes which will need to be implemented to assess impacts and review the effectiveness of the mitigation protocols. Details of the remedial actions available and prescriptions to moderate unacceptable impacts when detected should also be addressed in the Drainage Management Plan.

The Drainage Management Plan should be prepared as a separate document to the EMP and be available for review by regulatory authorities prior to the commencement of development.

- **Final Landform**

  Insufficient detail has been provided in the ERMP (pg. 142, 143) on issues related to the final landform, especially of waste dumps. This is particularly relevant to decommissioning issues and the maintenance of hydrological processes around the mine once operations ceases.

  The proponent's intent to backfill the mined-out pit to level above the water table is commendable.

- **Pit de-watering**

  No mention is made of the impact of pit de-watering on surrounding hydrological processes. Will pit de-watering affect the hydrology of the Coondewanna Flats and Lake Robinson areas to the north of The Governor?

  Have investigations been undertaken to determine if stygofauna exists in the water table in the areas adjacent to the mine which will be de-watered?

- **Borefield de-watering**

  Have investigations been undertaken to determine if stygofauna exist in the water table of the borefield. It was noted in the consultant's report (Woodward-Clyde 1997) that some test bores encountered cavernous substrates (eg. Bore No. WOB 9 / WTP 3, (site T)).

What will be the compounding affect of mine de-watering and the borefield development on the underground hydrology of the Turee Creek East Branch? This question is particularly relevant as this drainage system flows into the greater Turee Creek which itself is subjected to other de-watering programmes associated with the Channar and Paraburdoo wellfields. Hamersley Iron have in place a groundwater monitoring programme for their operations which will undoubtedly be influenced by the extent of groundwater drawdown and abstraction further upstream as a consequence of this project. Similarly, the regional impacts of these compounding affects on the groundwater hydrology of Turee Creek need to be considered, not only because this drainage system is an important tributary of the regionally significant Ashburton River but because other users will undoubtedly place demands on this precious resource. For example, Sipa Resources and Lynas Gold are investigating water reserves along Turee Creek for their Mt Olympus Gold development. It would seem appropriate to commission a regional groundwater study to obtain a better understanding of how the Turee Creek system functions. Such an approach would hopefully negate any conflicts and litigation issues arising in the future, such as those which are current between Roy Hill Station, BHP Iron Ore and the Government over the affects of the Ophthalmia Dam on hydrological processes along the Fortescue River.

- **Fire Management**

  The ERMP does not give any attention to fire management, particularly in the West Angelas area where there are many communities which are extremely susceptible to changes in fire regime, in particular changes in fire frequency. This is especially true for the mulga woodlands of the West Angelas area and approaching rail routes, but equally applies to the cracking clay communities and populations of conservation significant flora in this area. Similarly, fire management issues within the two National Parks adjacent to the rail routes should have been considered. It is acknowledged that this topic may be more appropriately addressed in the EMP, although a separate Fire Management Plan may be warranted given the significant conservation value of the Coondewanna and West Angelas areas.

  The proponent should be encouraged to formally enter into a management agreement with CALM, particularly in the West Angelas area which has significant conservation values. As previously discussed, a similar approach is required for the control on environmental weeds. Perhaps a Memorandum of Understanding over such issues, along similar lines to the agreement with Hamersley Iron would be appropriate. The proponent and CALM should be encouraged to pursue such an agreement. (Liaison on fire management, in particularly suppression, has already occurred).

- **West Angelas Access Road**

  Clarification on the location of the mine access road off the Great Northern Highway is required as there appears to be some confusion in the ERMP. In the ERMP (pg. 80) it is stated that the access road basically follows the existing road, which was the route described and botanically surveyed by the proponent's consultants. (Trudgen and Casson 1988, Vol. 1, pg. 189). However, in Figure 3.3 and on map 324539-10 of Appendix B of the ERMP the road is shown to be on the southern side of the Governor Range, which is approximately 4 km north of the existing alignment. On the map in Appendix B the Access Road parallels the Mt Robinson rail route option for most of its traverse to the Great Northern Highway. What is the correct alignment? If the correct alignment is the route along the southern side of the Governor Range then botanical details provided in the ERMP (pg. 80) are incorrect. Similarly, if the route is along the southern slopes of the Governor Range the portion of this alignment which was not coincidental with the alignment of the Mt Robinson rail route option needs to be accessed biological. CALM would prefer the access road be incorporated into the Mt Robinson rail route corridor consolidating any environmental impact to a single alignment, a previously discussed.

- **Power Supply**

  While the proponent acknowledges that a gas fired power station and associated pipeline is the preferred option, the possibility of obtaining power from Pilbara Energy Pty Ltd via transmission

lines to BHP Iron Ore's Area C has not been ruled out. No details have been provided in the ERMP on the route that such a power transmission line would take or the environment it would traverse. Consequently, the environmental impacts of this power supply option cannot be assessed. Prior to the proponent constructing such a transmission line an environmental assessment will need to be undertaken.

- **Borefield Pipeline**
  No environmental data or assessment has been undertaken on the route of the pipeline and powerline connecting the preferred production borefield, Turee Creek (B), with the West Angelas Mine Area, as depicted in map 324538-10 in Appendix B of the ERMP. This environmental data needs to be collected and an assessment undertaken.

- **Construction Water Sites Outside Development Area**
  Throughout the maps presented in Appendix B of the ERMP there are numerous water supply points identified. Many of these are outside the proposed and assessed development areas, especially along the various rail route options. Environmental assessments should be undertaken of these water supply options prior to their development to ensure that access tracks and associated activities do not have any adverse impact on significant flora and fauna populations.

  Many of the water supply sites along the Central Pilbara Railway section of the rail route are within the Karijini National Park. Prior to the development of such sites, in addition to environmental assessment, permission will need to be obtained from CALM. Liaison will need to be maintained with CALM if such sites are developed as the Department may request that some sites be retained as a water supply for use in general park management, particularly fire management. In at least one instance, where the water supply site is located on the Mt Bruce Flats, it is unlikely that CALM will support such a proposal, primarily because of the environmental sensitivity of the location.

- **Repeater Stations and Quarry Sites**
  No details are given in the ERMP on the location of communication repeater stations along the alignments of the proposed railway routes. If such sites are located outside the corridors assessed biologically then they will need to be individually assessed environmental to determine if any communities or populations of conservation significance will be affected. This is particularly relevant in the Hamersley Ranges where hilltops are refuges for populations of conservation significant flora.

  In the ERMP (pg. 38, map 324538-7 of Appendix B) two locations (Hamersley Iron's Hill D area) along the Four Corners Bore route are identified as possible quarry sites for the supply of ballast and aggregate. These sites do not appear to have been investigated biologically and will require assessment prior to development. It is acknowledged that the proponent has committed to obtaining appropriate approvals for the quarry sites prior to development (ERMP, pg. 38).

- **Tenure Data**
  Several of the figures used in the ERMP are based on outdated tenure. These figures either do not show the extent of the Millstream Chichester National Park or do not include the Mt Meharry and O'Briens Block additions to the Karijini National Park. In the later instance, some maps which show these two Karijini National Park additions have the parcels of land identified as Conservation Parks, a tenure status which was amended in 1994 to National Park. Examples include Figure 1.2, 2.1, 2.2, 5.4 and the index figure used on the vegetation maps in Appendix C.

- **Summary Document**
  In the Summary Document on page 13 it is stated in the Ground and Surface Water section that "watercourses in the region (West Angelas Area) drain into the Fortescue". This statement in incorrect as the area is principally drained by the East Branch of Turee Creek, a major tributary of the Ashburton River. This was noted in the proponent's consultant report dealing with Surface

Water Hydrology and Watercourses (Streamtec 1997). It is acknowledged that part of the eastern portion of the West Angelas Survey Area is drained by Pebble-mound Mouse Creek which is a tributary of the Fortescue River.

CITED REFERENCES

CALM (1989). Hamersley Range National Park, Draft Management Plan. Department of Conservation and Land Management, Como, Western Australia

CALM (1995). Karijini National Park, Draft Management Plan. Department of Conservation and Land Management for the National Parks and Nature Conservation Authority, Perth, Western Australia.

Dames and Moore (1984). Perth to Darwin National Highway - Newman to White Springs: Draft Environmental Review and Management Programme and Environmental Impact Statement.

Dunlop, J. N. and Porter, B. D. (1985). The Conservation of Mulga Communities in the South-East Pilbara, Western Australia. A report to the National Park Authority (WA) and the Department of Conservation and Environment(WA). Mulga Research Centre, Bentley, Western Australia.

EPA. (1992). Marandoo Iron Ore Mine and Central Pilbara Railway, Hamersley Iron Pty Limited: Report and recommendations of the Environmental Protection Authority. Environmental Protection Authority, Perth, Western Australia.

Fox, J. E. D. (1983). Mulga Study: National Highway Project. Report No. 1. Unpublished report prepared by the Mulga Research Centre for the Main Road Department.

Fox, J. E. D. and Carey, J. (1985). Mulga Study: National Highway Project. Report No 6. The Robinson Section. Unpublished report prepared by the Mulga Research Centre for the Main Road Department.

Fox, J. E. D. and Dunlop, J. N. (1993). Mulga Study: National Highway Project. Report No. 2. Unpublished report prepared by the Mulga Research Centre for the Main Road Department.

Mattiske, E. M. and Associates. (1992). Flora and Vegetation, Marandoo Project Area. Unpublished report prepared for Enviroscan. E. M. Mattiske and Associates Report No. 10.04.02

Shaw, J. F. D. (1995a). Juna Downs Station Resource Management Plan, Part 1: Recommendations for the sustainable management and rehabilitation of the pastoral resources on Juna Downs Station. Unpublished report prepared for Hamersley Iron Pty Limited.

Shaw, J. F. D. (1995a). Juna Downs Station Resource Management Plan, Part 2: A Resource Inventory and Condition Survey of Juna Downs Station. Unpublished report prepared for Hamersley Iron Pty Limited.

Streamtec (1997). West Angelas Iron Ore Project ERMP - Surface Water Hydrology and Watercourses. Report prepared for Robe River Iron Associates, September 1997.

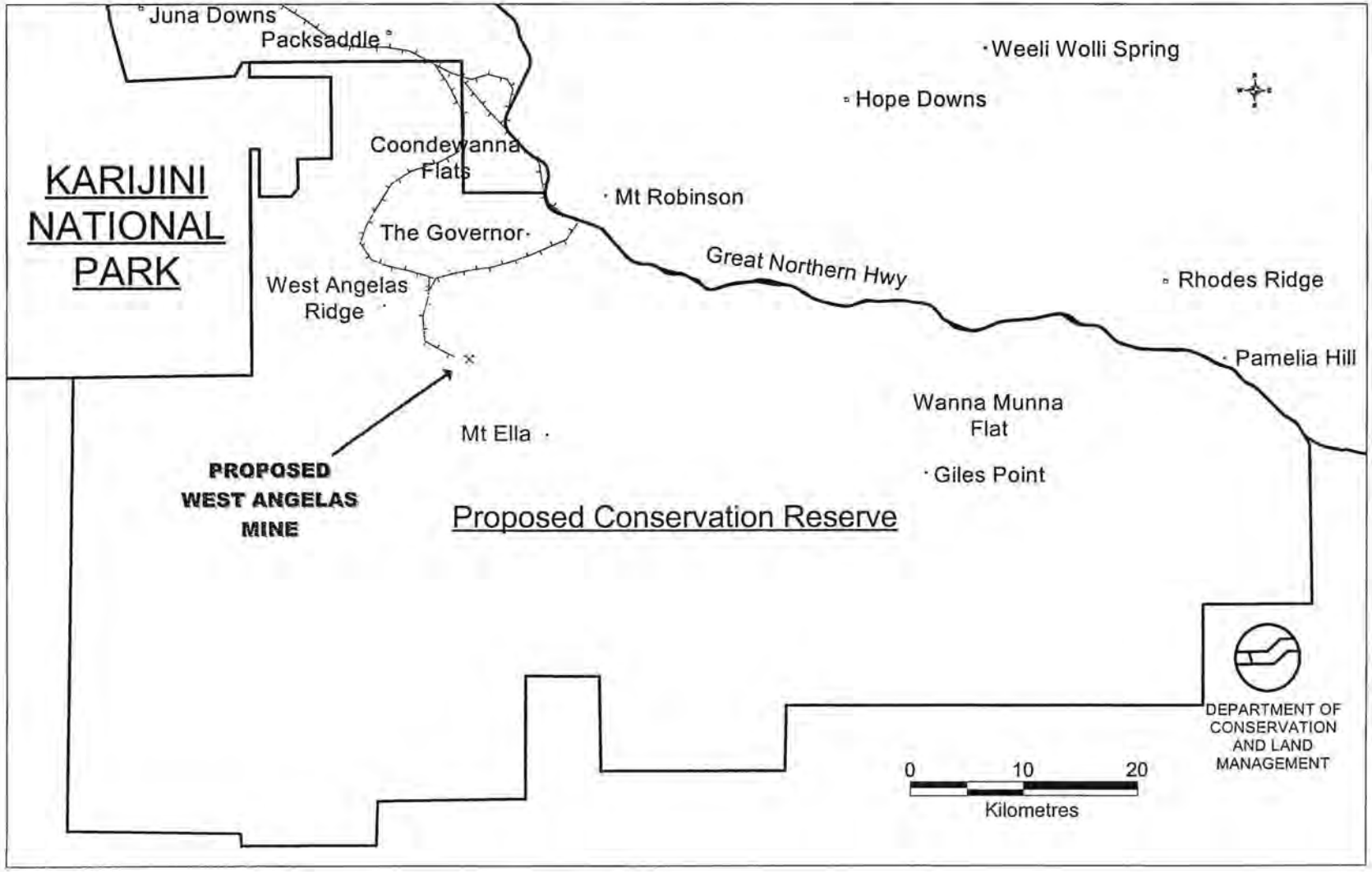
Trudgen, M. E. and Casson, N. (1998). Flora and Vegetation Surveys of Orebody A and Orebody B in the West Angelas Hill area, an area surrounding them, and of rail route options considered to link them to the existing Robe River Iron Associates rail line. Unpublished Report Prepared for Robe River Iron Associates, March 1998.

van Leeuwen, S. J., Muller, C., Bromilow, B. and Lipple, S. (1998). Conservation Values of Three Proposed Additions to the Hamersley Range Conservation Estate. CALMScience, in prep.

Weston, A. S. (1997) A vegetation and flora survey of a proposed route for a gas pipeline from the GGT pipeline to the West Angelas project area. Prepared for Robe River Iron Associates.

Woodward-Clyde (1997) Groundwater resource assessment - Turee Creek (Option B). Unpublished Report prepared for Robe River Iron Mining, 5 December 1997.

Attachment 1 Location of the West Angelas Mine in relation to the proposed multiple use 'Mulgalands' conservation reserve.



Attachment 2 Position of the various rail route options in the vicinity of the Coondewanna Flats and West Angelas Mine.