
**Pilbara Iron Ore & Infrastructure Project:**
**Cloud Break**
**(Assessment No. 1577)**

**Response to Submissions**
**(And Additional Studies)**
**November 2005**

**for**

**Fortescue Metals Group Limited**

Fortescue Metals Group Limited
P.O. Box 910
West Perth WA 6872
Australia

Telephone: +618 9266 0111
Facsimile: +618 9266 0188
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## 1. INTRODUCTION

The public submission period for the Pilbara Iron Ore and Infrastructure Project: Cloud Break Public Environmental Review (PER) commenced on 12 September 2005 for a period of six weeks, ending on 24 October 2005. The EPA accepted submissions up to 2 November 2005.

Ten submissions were received by the Environmental Protection Authority (EPA). Submissions were made by State Government bodies, organisations and individuals.

The issues raised within the submissions have been classified as biophysical, pollution, social or other issues (Sections 4-7). They have been further sorted into various subcategories for ease of response. A summary of the topic areas covered by each submission is given in Section 8.

This report also includes a report on further investigations into re-establishment of sheet flow and the details of related offset packages. These have been completed since the release of the Public Environmental Review (see Section 3 and appendices).

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## 2. OVERVIEW OF SUBMISSIONS

A total of ten submissions were received. Of these, six opposed the Project in its current form (see Section 9). The remainder, whilst raising some issues of concern, could be regarded as neutral.

The submissions covered a wide range of issues. Some issues received attention in more than one submission or were the subject of significant commentary within individual submissions. The main issues included:

- *Fortescue Marsh and future conservation areas*: Five submissions highlighted the regional and national importance of the Fortescue Marsh which supports a rich diversity of waterbirds when in flood. Three of these submissions also expressed concern that a portion of the Cloud Break Project area overlaps an area of proposed conservation estate for the protection of the Fortescue Marsh and surrounding Mulga lands. These issues are addressed in Sections 4.1 (Future Conservation Areas) and 4.2 (Fortescue Marsh).

- *Surface water impacts and associated vegetation impacts*: Seven submissions discuss the potential impacts of the Project on surface water flows, with four expressing concern over the potential disturbance to surface water sheet flows, and resultant impacts on vegetation communities that are dependent on these sheet flows (e.g. mulga grove communities). Two of these submissions also highlighted the importance of designing the Project to withstand expected flood events. These issues are addressed in Sections 4.3 (Surface water) and 4.4 (Sheet flow and Mulga woodlands).

- *Groundwater abstraction and associated impacts*: Dewatering of the pits will be required as mining progresses. Eight submissions expressed concern over the abstraction of groundwater and the disposal options for this water. There was concern that lowering the watertable during abstraction may alter the hydrodynamics of the Fortescue Marsh, remove large areas of stygofauna habitat and adversely affect phreatophytic vegetation. These issues are addressed in Sections 4.5 (Groundwater and phreatophytic vegetation) and 4.10 (Stygofauna).

- *Vegetation impacts, particularly large-scale clearing, weed management and rehabilitation*: Six submissions discussed the potential impact on flora and vegetation including one submission concerned over the potential introduction and spread of weeds from Project areas. Five submissions stated the need for appropriate rehabilitation measures, some of which noted the limitations of conventional rehabilitation techniques. These issues are addressed in Sections 4.6 (Flora and vegetation), 4.7 (Weed management) and 4.11 (Rehabilitation and closure).

- *Impacts on terrestrial and aquatic fauna including stygofauna*: Four submissions raised as a concern the potential impacts of the Project on local fauna populations, particularly the Night Parrot, Bilby and waterbirds using the Fortescue Marsh. One of these submissions critiqued the fauna survey methodology. Three of the submissions were concerned about the potential impacts on stygofauna and the adequacy of sampling work done to date. Three submissions noted the lack of invertebrate sampling, including one regarding aquatic invertebrate sampling around the Fortescue Marsh. Noise impacts from blasting and general mining activity were discussed in three submissions. These issues are addressed in Sections 4.8

(Terrestrial fauna), 4.9 (Night Parrot), 4.10 (Stygofauna), 4.8.10 (Aquatic Fauna) and 5.3 (Noise and blasting).

- *Dust impacts*: Four submissions discussed potential dust issues, including dust smothering vegetation and the need for 'ore conditioning' to ensure adequate moisture content of the ore to minimise the potential for dust generation during handling at the port. Dust issues are addressed in Section 5.1.

- *Cumulative impacts:* Six submissions raised the concern over potential cumulative impacts from FMG's and other parties' projects in the region. The concerns were mainly in relation to vegetation disturbance and surface drainage (Section 4.6), terrestrial fauna (Sections 4.8 and 4.9), dust (Section 5.1), greenhouse gas emissions (Section 5.2) and noise (Section 5.3).

Other issues raised included:

- Greenhouse gas emissions (four submissions; Section 5.2);
- Acid mine drainage (two submissions; Section 5.4);
- Lack of adequate consultation (one submission; Section 6.1);
- Impacts on pastoral activities (one submission; Section 6.2);
- Selection of mining and processing methods (three submissions; Sections 4.11.3 and 5.7);
- Interaction of the Cloud Break Project with FMG's other projects and options for transport of ore (four submissions; Sections 7.3.1 and 7.5);
- Assessment under the WA *Environmental Protection Act (1986)* and consistency with EPA Guidelines and Position Statements (five submissions; Sections 4.8.1 and 7.1);
- Proponent commitments (four submissions; Sections 4.3.12, 4.8.23, 4.8.26, 4.11.7, 4.11.9, 4.11.10, 6.1.13, 7.1.3);
- General site environmental management (two submissions; Section 7.3);
- Environmental offset package (one submission, Section 3 and 7.4); and
- Peer reviews of studies (two submissions, Sections 4.2.11 and 4.8.19).

No change to the proponent commitments included in the Cloud Break PER is proposed although the content of some of the management plans will change following comments received in submissions.

# 3. OFFSETS

## 3.1 STAGE B OFFSETS

The EPA have recently assessed FMG's Stage B Project (east-west rail and mines), which are located in the Chichester footslopes and the Hamersley Ranges. The Stage B Project contained 36.4 $km^2$ of land systems containing Mulga within the Chichester footslopes management unit. In addition to the disturbance to vegetation, FMG also committed to offsets for threatened fauna species which were identified during the Stage B fauna assessments.

In order to mitigate impacts on the Mulga woodlands as a result of the Project, offsets were considered in consultation with the Department of Conservation and Land Management (CALM). Further information on these offsets is provided below.

- Weed Management Programme outside the area of disturbance of the Project to improve the existing environment.
- PhD or research equivalent into Mulga and its relationships with (surface) water.
- PhD or research equivalent into the conservation values of the Chichester footslopes Mulga woodlands.
- Honours project into the conservation values of Mulga.
- PhD or research equivalent into threatened species such as the Mulgara.
- Contribution to the development of a Fortescue Marsh Management Plan by CALM.
- Funding a position within CALM to help manage the FMG project implementation and ensure the conservation of environmental values in the area.

FMG will also work to develop a Memorandum of Understanding between CALM and FMG to facilitate the collaborative working relationship required to manage the environmental values of the region. The detail of the Memorandum of Understanding contained in the Stage B offsets package is outlined below.

## 3.2 MEMORANDUM OF UNDERSTANDING

Through offset packages developed for Stage B and Cloud Break, FMG and CALM will be required to work collaboratively together for the duration of the Cloud Break Project.

It is FMG's aim to maintain a good working relationship with CALM. As such, FMG proposes that a "Memorandum of Understanding" (MOU) be developed between both organisations which outlines;

- Further details on the operational aspects of each offset;
- A process for agreeing on key inputs and deliverables;
- Key dates and milestones;
- Communication processes and protocols; and
- Responsibilities and accountabilities.

It is proposed that this MOU is developed in collaboration by both parties prior to commencement of construction, in accordance with FMG's Project timeline. A pre-requisite for the development of the MOU is a firm commitment from CALM to work to the FMG Project timeline, to ensure it is developed prior to Cloud Break construction. FMG makes no commitment to delay the Project construction, if

the MOU is not finalised.

## 3.3 PROPOSED CLOUD BREAK OFFSETS

The Cloud Break Iron Ore mine is located in the same region as the Stage B proposal and the offset package that has been developed for the Cloud Break proposal is therefore linked to the above offset proposal for Stage B. In addition, the development of the offset package for Cloud Break is to complement that which has already been developed as part of the Stage B offset negotiations.

### 3.3.1 Land Acquisition

In recognition of the conservation importance of the Fortescue Marsh to the State of Western Australia and the potential for this area to be listed as a RAMSAR wetland in the future, FMG will commit to providing resources to CALM to enable them to acquire the area nominated for exclusion from the 2015 pastoral lease negotiations for early inclusion to the conservation estate.

FMG will provide the funds to CALM which are to be held in a trust fund and be used to purchase land important to the conservation estate. While negotiations for the areas to be purchased will be undertaken by CALM, FMG is to be consulted as to the proposed areas to be purchased. The money to be provided for land acquisition will be committed once the Project is operational and will be provided over a 2 to 3 year period.

### 3.3.2 Research Projects

Outlined below is the range of research projects proposed as part of the Cloud Break Offset proposal:

- Research into the Night Parrot;
- Research into the Bilby; and
- Research into improving understanding of local conservation values, which may include short range endemic invertebrates, fire ecology of *Acacia xiphophylla* or samphires.

Fauna surveys for FMG's Cloud Break PER identified the existence of threatened species near the Project area. FMG has committed to considering appropriate offsets for threatened fauna as part of the Cloud Break Project.

Currently, there are no established survey techniques for the Night Parrot and this will limit the ability to develop research projects into the species. FMG will, as part of its ongoing operations, continue to undertake surveys for the Night Parrot to try to establish appropriate survey techniques. However, if and when an established technique is determined to allow the safe capture, tag and release of this species FMG would fund an ongoing research project into the Night Parrot.

In addition to the research offset proposed for Stages A and B (PhD level or equivalent), FMG will commit to the following additional research / funding:

- One research project at PhD level or equivalent, to be run consecutively for a period of at least nine years; or
- A funding proposal (of similar cost to a PhD Project) which contributes to knowledge / research for the Night Parrot.

The Research Project / Funding Proposal will be developed in consultation with CALM, the federal Department of Environment and Heritage (DEH) and Academic Advisors through the following collaborative process:

- Desktop review of all current research in the Pilbara area, relevant to the potential impacts of FMG's Cloud Break Project, concerning Night Parrot.
- Discussions with CALM / DEH regarding research that requires further work / funding or possible new areas of research / funding, to better understand and manage the impacts of mine infrastructure on the Night Parrot.
- Consultation with CALM / DEH to select an appropriate area of research / funding to be pursued.

If a PhD project is proposed the following process would then also be undertaken:

- Initiate discussions with Academic Advisors and Experts in the field of study selected in order to scope the Research project further.
- Develop a Scoping Document describing the potential methods, timing and deliverables for the Research Project.
- Select a study team or individual to carry out the work, provide adequate resourcing, technical support, academic and/or expert advice and set a start date for the research.

FMG will also develop an integrated research programme aimed at further understanding and protecting the Bilby. This will include the following research projects:

- One research Project at PhD thesis level or equivalent will be conducted consecutively for a period of nine years; or
- A funding proposal (of similar cost to a PhD Project) which contributes to knowledge/research for the Bilby.

Commencement of the research programme will occur once construction is complete and will be reviewed every three years, in consultation between FMG, CALM and Academic Advisors. The scope of research to be undertaken will be developed in collaboration with CALM through the following process:

- Desktop review of all current research in the Pilbara area, relevant to impacts of FMG's Cloud Break Project, concerning Bilby.
- Discussions with CALM regarding research that requires further work or possible new areas of research.
- Consultation with CALM to select appropriate areas of research to be pursued, but would consider their current numbers, distribution range, populations trends and pressures on current populations.
- Initiate discussions with Academic Advisors and Experts in the fields of study selected in order to scope the Research Programme further.
- Develop a Scoping Document describing the potential methods, timing and deliverables for the Research Programme.
- Select a study team or individual to carry out various components of the work, provide adequate resourcing, technical support, academic and/or expert advice and set a start date for the research.

The above process to scope the nine year research effort will commence at the outset of Project

construction.

FMG will also develop an integrated research programme aimed at further understanding the conservation values of the Fortescue Marsh. This will include:

- One research project at PhD thesis level or equivalent will be conducted consecutively for a period of nine years; or
- A funding proposal (of similar cost to a PhD project) which contributes to knowledge/research for the conservation values of the Fortescue Marsh.

Commencement of the research programme will occur once construction is complete and will be reviewed every three years, in consultation between FMG, CALM and Academic Advisors. The scope of research to be undertaken will be developed in collaboration with CALM through the following process:

- Desktop review of all current research in the Pilbara area, relevant to impacts of FMG's Cloud Break Project, concerning the conservation values of the Fortescue Marsh focusing on short range endemic invertebrates, fire ecology or samphires.
- Discussions with CALM regarding research that requires further work or possible new areas of research.

### 3.3.3 Predator Control Programme

The management plans that have been developed for the Night Parrot and Bilby have identified that pressures on endangered species populations include feral predators, such as foxes, cats and wild dogs. Managing these species is potentially an important part of maintaining and conserving populations of endangered species. While small scale programmes will be conducted as part of FMG's operating practices, the development of a broad scale programme to control predators over a much larger area is necessary before any benefits will be registered. Therefore, in addition to funding research into the conservation of threatened fauna species, FMG will also commit to contributing to a CALM Predator Control Programme for the Fortescue Marsh area.

The Project will be ongoing for the life of the Project and will be scoped between FMG personnel, CALM and academic experts in this field. The responsibility for the management of the programme will be undertaken by CALM as part of its current Pilbara regional predator control programmes. This project should commence as soon as practicable after commencement of construction of the Project.

### 3.3.4 Fencing

FMG recognises that another key pressure on threatened fauna species and native vegetation are the impacts associated with grazing activity in their vicinity. While FMG will liaise with affected landholders regarding the impacts of the Project on their pastoral stations that may require the restrictions of grazing animals in certain areas, there is a broader concern regarding grazing and predator pressure on native vegetation and threatened fauna species.

FMG will commit to providing funding to CALM to enable them to fence areas that they acquire through resources provided by FMG to acquire land for conservation purposes. The final areas to be fenced and the type of fencing will be determined between FMG personnel and CALM.

# 4. BIOPHYSICAL

The following section summarises and addresses biophysical issues that were raised in the submissions.

## 4.1 FUTURE CONSERVATION AREAS

### 4.1.1 *The PER does not indicate on a map, nor describe the area that CALM has nominated for conservation purposes when the pastoral leases expire on 20 June 2015. This would provide some indication of areas recognised by CALM with high conservation values. (Submission 4)*

Figure 22 of the Cloud Break PER illustrates the areas proposed for conservation when the pastoral leases expire in 2015 and the overlap of a portion of these areas with the Project. Of the 2015 pastoral lease exclusion area (213,400 ha), 1.6% is overlapped by the proposed Cloud Break Project and 0.04 % is overlapped by the revised Stage B Project.

### 4.1.2 *The Project area is important from a biodiversity perspective, and the Pilbara region has been recognised as one of 15 national biodiversity hotspots. We also note the limited representation of the area in conservation reserves, and that the Project will overlap with areas that would otherwise be the subject of 2015 pastoral lease exclusion. On this basis alone we oppose the Project going ahead. The Society does not support this proposal, as the impacts on vegetation and the Fortescue Marsh and surrounds will be compromised. The Fortescue Marsh is an area of high conservation value that should be conserved. (Submission 4)*

FMG recognises the conservation value of the Fortescue Marsh. Within the vicinity of FMG's Project, several vegetation communities of high conservation significance were identified. These include the samphire flats which fringe the Fortescue Marsh (Mattiske Consulting, 2005) and a Mulga-dominated vegetation community on seasonally-wet broad drainage areas (Fa10) identified by Biota (2004). The Cloud Break Project and the revised Stage B Project will not directly impact upon these vegetation communities. Further, FMG has developed management measures to reduce the risk of indirect impacts on these communities from the proposed mining developments (Section 6.2 of the PER).

It is FMG's belief that, by conducting its activities in an environmentally responsible manner so as to not adversely impact the overall conservation values of the Fortescue Valley, any future Conservation Reserve proposal in the area can co-exist with FMG Project and bring about positive outcomes for the environment and community. FMG has committed to avoiding impacts on the Fortescue Marsh and its immediate surrounds, and to ensure the conservation value of these areas is not reduced as a result of FMG's operations in the Fortescue Valley.

### 4.1.3 *The EPA should not be approving this proposal because of the high environmental values of the area, which we believe need to be better defined for environmental review. Prior to approval of this Project, we would also like to see the environmental track-record of the company at its other Project sites. We believe that this Project should be considered after the 2015 pastoral lease assessment. (Submission 4)*

FMG believes that with the proposed management measures, the Project can proceed in an

environmentally responsible manner to minimise the impacts on the recognised environmental values of the area. FMG has committed to a number of offsets (see Section 3) and specific actions to minimise the risk of potential impacts such as:

- designing infrastructure to avoid Declared Rare and Priority Flora, Specially Protected (Threatened) Fauna habitats, and species of Conservation Significance;
- implementing a Rehabilitation and Revegetation Management Plan, to address the impact of vegetation clearing;
- implementing a Fire Management Plan;
- implementing Threatened Fauna species management plans;
- implementing the Borefield and Dewatering Management Plan, including the Groundwater and Vegetation Monitoring Programmes; and
- implementing the Subterranean Fauna Management Plan.

FMG has a window of opportunity to respond to the current and forecast global demand for iron ore that exceeds supply. If the Project is delayed until FMG's other projects can demonstrate an environmental 'track-record', or until after 2015, then it is very likely that this opportunity will have been lost to overseas projects with the loss of potential benefits to the Pilbara region, Western Australia and the nation. FMG expects to operate under stringent conditions set by the Minister for the Environment and monitored by the Department of Environment.

#### 4.1.4 *The proposed "Mulgalands Conservation Park" not shown on Figure 1. (Submission 4)*

Figure 22 in the PER outlines the areas that will be released from Pastoral Lease in 2015 and which are proposed by CALM to be included into the conservation estate. This figure also shows the pit layouts, workshops and other associated infrastructure associated with the proposed mine development.

#### 4.1.5 *How would the proposed Cloud Break Project affect the quality of the proposed exclusion area on the Mulga Downs station? (Submission 5 – Table 1).*

Of the 2015 pastoral lease exclusion area (213,400 ha), only 1.6% is overlapped by the proposed Cloud Break Project. It is FMG's belief that by conducting its activities in an environmentally responsible manner, any future Conservation Reserve proposal in the area can co-exist with FMG's Project.

Refer also to 4.1.3 and 4.1.7.

#### 4.1.6 *The conservation values of the Fortescue Valley obviously include the existing vegetation communities and the habitat it provides for significant species such as the Night Parrot. Given that about 5,500 ha of vegetation would be removed over the life of the proposed Project, have vegetation offsets been considered? If so, are they on Mulga Downs station? (Submission 5 – Table 1).*

FMG is considering a number of offsets which are described in more detail in Section 3 of this Response to Submissions. These offsets include investigations into flora and fauna with high conservation values and will complement the offsets proposed for FMG's Stage B Project.

**4.1.7** ***The proposed mine site occurs within two pastoral leases that were identified by CALM for exclusion in 2015 for future addition to the conservation reserve system. The proposed mine occupies a significant portion of the Mulga Downs and Hillside exclusions (approximately 26.5% of the combined exclusion areas from the two leases). (Submission 10)***

The Cloud Break Project occupies approximately 4.45% of Mulga Downs and Hillside Station areas within the proposed CALM Exclusion Areas and the Christmas Creek operations only 0.14% (see Table 1 and Figure 1). This amounts to a total of less than 5% of CALM's Exclusion Area on Mulga Downs and Hillside Stations and about 1.6% of CALM's overall Exclusion Area. FMG is unsure how the submitter calculated the figure of 26.5%.

**Table 1: CALM Exclusion Areas on Mulga Downs and Hillside Stations and the impacts of FMG operations.**

| Land | Area ($km^2$) | % |
|---|---|---|
| Total of CALM Exclusion Areas within Mulga Downs and Hillside Stations | 776.5 | 100 |
| Area of Cloud Break operation within CALM Exclusion Area on Mulga Downs and Hillside Stations | 34.5 | 4.45 |
| Area of Christmas Creek operation within CALM Exclusion Area on Mulga Downs and Hillside Stations | 1.1 | 0.14 |
| Total area of FMG operations within CALM Exclusion Area on Mulga Downs and Hillside Stations | 35.6 | 4.59 |

**4.1.8** ***Whilst it is recognised in the PER that the proposed Cloud Break mine is located on the areas proposed for addition to the conservation reserve system in '2015' (p. 146), the process for reservation outlined in the PER is inadequately represented. (Submission 10)***

FMG believes that that the brief description provided in the PER does reflect the process that will be necessary in 2015 to vest these areas as conservation reserves. FMG has clarified the process with the Department of Planning and Infrastructure (DPI). The DPI confirmed that for a conservation area to be established, a reservation order under s41 of the *Land Administration Act (1997)* is necessary. Prior to this occurring, consultation occurs and based on this the final boundaries of the conservation reserve may change to take into account additional values.

**4.1.9** ***The statement in the PER that "the 2015 Exclusion Zones have not yet been formally proposed as a Conservation Reserve" (p. 146) is not accurate. Whilst consultation will be required with stakeholders such as local government, the Department of Industry and Resources, and native title claimants, it must be recognised that the exclusion of these lands for a public purpose is provided for in current State legislation and has been endorsed by the State Government. (Submission 10)***

FMG understands that the State Government has agreed for the area to be excluded from the Pastoral lease renewal for a public purpose (as per s143 6(d) of the *Land Administration Act (1997)*), on advice from CALM. However, the formal process to reserve the land as a conservation reserve has yet to commence. This will occur when it becomes vacant crown land in 2015.

**4.1.10** ***CALM notes the proponent's view, as stated on page 147 of the PER, that "any future Conservation Reserve proposal in the area can co-exist with FMG Projects to bring about positive outcomes for the environment". CALM's view is that, for this to be a plausible proposition, the proposal would need to ensure that all environmental risks are fully understood and avoided, adequately reduced or mitigated, and the State would need to be satisfied that the Project delivered a 'net conservation benefit' or 'no net loss' outcome. This has not been demonstrated in the PER. (Submission 10)***

FMG believes that the comment on p147 of the PER which states "It is FMG's belief that by conducting its activities in an environmentally responsible manner, so as to not adversely impact the overall conservation values of the Fortescue Valley, any future Conservation Reserve proposal in the area can co-exist with FMG Projects to bring about positive outcomes for the environment and community" remains valid..

FMG also agrees with CALM that this requires the need to understand and follow the EPA's guidance regarding sequence of mitigation which involves the avoidance, minimisation, rectification, reduction and offsets hierarchy to deliver a 'net conservation benefit' or 'no net loss' outcome. FMG believes that through the biological studies that have been conducted, the development of management plans and strategies to manage the risks, the appropriate rehabilitation of the area against accepted completion criteria and other mechanisms, the overall conservation values of the Fortescue Valley will not be diminished by the development of the Project.

## 4.2 FORTESCUE MARSH

**4.2.1** ***The proponent has been unable to demonstrate that it has an adequate understanding and appreciation of the biodiversity values of the Fortescue Marsh catchment and the impacts of the proposal to ensure that these values can be protected. (Submission 10)***

As stated in the PER, it is FMG's belief that by conducting its activities in an environmentally responsible manner any future conservation reserve can co-exist with FMG's Project.

FMG has conducted extensive biological surveys in the vicinity of its Project and will continue to conduct ongoing surveys to increase its understanding of the environment. In addition, FMG believes that the development of appropriate management plans and procedures, developed with the input from key stakeholders like CALM and the Department of Environment (DoE), to mitigate any potential detrimental aspect of the activity, can deliver a no net loss outcome.

The studies that have already been carried out in the PER will contribute to the preparation and implementation of management plans. These plans shall include descriptions of monitoring, trigger levels, and management actions. By implementing these plans, FMG is confident that the values of the Marsh will be protected.

**4.2.2** ***Concerned over the significant disturbance this clearing will have on some fauna habitats (incl. bilby and night parrot) and potential to negatively effect surface water movement in the affected areas (including increased likelihood of erosion and sedimentation) and concern this will have on the recharge and dynamic of the Fortescue Marsh. (Submission 2)***

As stated in Section 6.3 of the PER, the Project will be designed to minimise disturbance to, or avoid, significant fauna habitats where practicable. Specific management measures will be implemented to ensure that the Project does not adversely impact the conservation status of Threatened species. FMG has specifically developed a Night Parrot Management Plan and a Bilby Management Plan that have been reviewed by CALM. These Plans contain strategies regarding FMG's operations near these species.

FMG recognises the potential for clearing and establishing mines and infrastructure, to affect surface water movement. FMG is also aware that these changes have the potential to increase erosion and sedimentation, and to consequently affect the downstream Fortescue Marsh. FMG has outlined a number of strategies in Section 6.5 of the Cloud Break PER regarding surface water management to minimise the impacts in the Project area. These include but are not limited to:

- sediment traps;
- rip rap pads to diffuse water flows; and
- diversion of water flows.

Additionally as mentioned in response to 4.4.1, FMG has completed a number of trials to assist in the design of engineering structures to ensure that surface water flows are maintained. The management strategies to be adopted for surface water are outlined in Section 6.5.1 of the Cloud Break PER.

**4.2.3** ***Concerned over the effect the proposed mine will have over the recharge and flow of water to Fortescue Marsh. Management plan needs to be developed so as to ensure that surface water will not be lost from the Fortescue Marsh due to the development of pits and re-routing of flows in the catchment of the marsh. (Submission 2)***

***Pits to 70 m depth and overburden stockpiles will substantially alter topography and thus ephemeral drainage into localised areas of the Fortescue Marsh (proposed conservation area). (Submission 4)***

The Fortescue Marsh is a surface water feature, which forms after significant rainfall events result in overland sheet-flow and cause the creeks to flow. The maximum area of pits open at any one time will not exceed 0.03% of the catchment, even when the Stage B and the Cloud Break Projects are considered together. Therefore any changes to the frequency of flooding of the Marsh as a result of FMG's mining activity are expected to be insignificant. Further information on the impact of the Project on surface water flows is provided in Section 4.3.

FMG has identified that, if the dewatering of the pits resulted in a cone of depression that extended below the Fortescue Marsh, then there is a risk of the Marsh draining more rapidly. However, work undertaken by Aquaterra shows that it is unlikely that the cone of depression will extend to the Marsh. Nevertheless, monthly monitoring of 30 new monitoring bores and a further 22 existing bores (mainly

station bores) located throughout the Fortescue Valley has commenced for the FMG Project to obtain accurate groundwater reference levels (Aquaterra, 2005). Prior to commencement of pit dewatering, FMG will install additional monitoring bores between the pits and the Fortescue Marsh.

The information collected from these bores will be used to determine the natural seasonal fluctuations in groundwater levels, prior to the start of mining. Given the large variation in annual and seasonal rainfall in the Project area, the range in water levels from year to year is expected to be large. However, in light of the lack of historic groundwater level data for the area, and the short lead-time to the start of mining, it is likely that the monitoring plan will not measure the full range of seasonal fluctuations (though this will depend upon the pattern of seasonal rainfall between now and the start of mining). Therefore, as well as monitoring the seasonal range of water levels, FMG will use the numerical groundwater model to predict the range of water levels.

A range of trigger levels will be developed for each of the monitoring bores between the pits and the Marsh. Because the cone of depression will radiate from the pits, it will be possible to monitor the development of the cone of depression in bores close to the pits, against these trigger levels, well before the cone approaches the Marsh. If an observed water level close to the pit is lower than that which was predicted from the modelling, then this will enable FMG to develop an appropriate contingency plan to prevent impact on the Fortescue Marsh. The contingency plan may include changes to mining sequences and schedules to reduce or cease dewatering in critical areas; re-injection of dewatering water; or alternative engineering controls to reduce inflow of groundwater into the pits. Further information on the Project's impacts on groundwater is presented in Section 4.5.

**4.2.4** ***There is little known about the recharge of the Fortescue Marsh and the Group finds it totally unacceptable that bore monitoring is taking place now till mid year and that the results are supposed to show anything conclusive either way. This past 12 months is renowned to have been one of, if not the driest 12 months in recent history in the Project area and studies over such a short timeframe should not be relied upon as any basis for what effects there may be over the recharge of the Marsh. Further detailed studies need to examine this process. It is accepted that the Marsh does not recharge by groundwater and as such all efforts should be directed to ensuring that there is minimal to no interference over runoff water volume loss in the vicinity of the Marsh. (Submission 2)***

FMG has commenced extensive and detailed studies to determine the relationship between the surface water of the Marsh and the groundwater system. These include:

- Monthly monitoring of 30 new monitoring bores and a further 22 existing bores (mainly station bores) located throughout the Fortescue Valley.
- Weekly water level monitoring of water levels in the marsh obtained from three stage boards installed by FMG.
- Water quality sampling from all the bores between Cloud Break and the Marsh and down-hole geophysical logging of a sample of bores to provide further information on seasonal changes to water quality.
- Detailed numerical modelling to simulate the impacts of the pit dewatering on the marsh. This modelling uses the historic rainfall data, not just the previous 12 months, to simulate the impacts of the Project under a range of rainfall conditions.

This data will provide further insight to the recharge/discharge mechanisms of the Marsh.

In addition, FMG and its consultants have determined that the surface water catchment to the Marsh will be reduced by only 0.03% at any one time when considering the area of open pits at both the Stage B and Cloud Break mines. This amount is expected to be insignificant in the context of natural seasonal variations in run-off resulting from year-to-year changes in rainfall.

See also response 4.2.3.

**4.2.5** ***Changes to the hydrological regime as a result of clearing and dewatering have the potential to upset ecological processes in the Fortescue Marsh and associated ecological communities. (Submission 7)***

Groundwater abstraction for pit dewatering for the Cloud Break Project is not predicted to have any impact on the frequency of flooding at the Marsh. However, where groundwater levels are lowered significantly, an increased amount of water would be required to fully saturate the profile, and this could reduce the duration of surface water ponding.

The Aquaterra Surface Hydrology Report for the Cloud Break Public Environmental Review (provided as Appendix B to the PER) investigated the potential impacts of the Project on the surface hydrology of the Project area and the Fortescue Marsh. The study noted that there was the potential for reduced surface water runoff volume to the downstream environment including the Fortescue Marsh (pg. 8).

However, in concluding, the report stated that “assuming open pits totalling 925 ha are open at any one time, the area of total catchment not available for surface water runoff represents 0.03%.” (pg. 12). These are considered conservative estimates as FMG would minimise the total area open at any one time, and divert where practicable, surface water flows from upstream of the Project into adjacent surface water pathways or, existing downstream flow pathways.

FMG recognises that the proposed Cloud Break Project may alter the hydrological regimes at a local level. As detailed in the PER, for sheet flow areas located downslope from the open pit areas, FMG has committed to discharging diverted flows over riprap pads to encourage flows to slow and disperse. Downstream from working pits, FMG will conduct selected irrigation and or other management measures of sheet flow dependent vegetation, following significant rainfall events.

**4.2.6** ***The Marsh is an ecosystem dependent upon surface flow and surface flow catchment and are therefore very sensitive to any possible loss in catchment size. This area has never been studied, so it is uncertain what the effect may be and studies conducted now are in an abnormal year in terms of amount of rainfall received to date. The combination of the open pit areas could potentially impart detrimental implications on the survival of surrounding mulga stands. Hence the precautionary principle should be applied in this instance in regards to the mulga and limit of threatening processes. (Submission 2)***

Refer to responses to questions 4.2.4, 4.2.5 and Section 4.4.

**4.2.7** ***Fortescue Marsh is:***

- ***listed on Australian Heritage Commission Register of National Estate "Indicative Place";***
- ***listed on Directory of Important Wetlands in Australia (supports a rich diversity of waterbirds when in flood); and***
- ***portions on which the Project occurs have been nominated for conservation purposes when the pastoral leases expire on 20 June 2015. (Submission 4)***

***Section 6 of the PER attempts to address the environmental impacts and management strategies of this proposal. We do not believe that the strategies will adequately manage or mitigate the impacts on the Fortescue Marsh. (Submission 4)***

FMG is aware that Fortescue Marsh is an important wetland habitat. A risk assessment was commissioned as part of the Stage B assessment to investigate at possible risks on the Fortescue Marsh from the Pilbara Iron Ore and Infrastructure Project. Based on the proximity of the Cloud Break Project to the Stage B Project, the information contained within the risk assessment is considered applicable to the Cloud Break Project.

The risk assessment was undertaken by a range of expert consultants and FMG personnel, and was carried out in line with applicable standards for risk assessments. In summary the inherent risks (without controls) were found to be low in most cases due to the geographical separation of the mining areas from the Fortescue Marsh, and the fact that the active mining area will represent only 0.03% of the Fortescue Marsh catchment. The majority of drainage into the Fortescue Marsh area is received from the Fortescue River at the eastern end of the marsh and Weeli Wolli Creek on the south western side of the marsh. The overall residual risk to the Fortescue Marsh system as a result of FMG Project was found to be minimal when control measures were considered (Section 6.5.4 of the PER).

As part of its offsets programme, FMG has committed to working with CALM to assist in developing a Fortescue Marsh Management Plan. This plan will identify the conservation values of the Fortescue Marsh and the surrounding area (such as the Chichester Footslopes Mulga Woodland) and will outline:

- future management objectives;
- opportunities and risks;
- management strategies;
- a proposed monitoring programme; and
- areas requiring further research.

The Plan discussed above is a statutory management plan used for the management of protected areas as required under the *Conservation and Land Management Act 1984*. It differs from the internal Plan that FMG will develop to manage the potential impacts of its operations on the Fortescue Marsh.

**4.2.8** ***There is little background information on water quality of the Fortescue Marsh. Two major impact pathways have been identified that have the potential to threaten the Marsh's values. FMG should be required to complete baseline monitoring of the marsh as well as monitor and manage any impact to the Marsh resulting from their operation. (Submission 7)***

FMG is committed to ensuring that its operations do not adversely impact the Fortescue Marsh, and will, as a requirement of the Stage B approval, develop and implement a Fortescue Marsh Management Plan that will also cover the Cloud Break area. This Plan will be developed to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority. Specifically this management plan will outline the process for:

- establishing the baseline health condition of the adjacent Fortescue Marsh prior to construction undertaken as part of the proposal;
- monitoring and assessing any changes in the health of the adjacent Fortescue Marsh attributable to the Project; and
- implementing appropriate actions, where necessary, to maintain the health of the adjacent Fortescue Marsh.

This management plan will assist FMG in understanding the current condition of the adjacent Marsh, any changes in this condition, and to act proactively in protecting the Marsh.

**4.2.9** ***The proponent needs to demonstrate that the delineated boundary of the Fortescue Marsh mapped in the PER, as taken from the Australian Nature Conservation Agency (ANCA) boundary, is a true reflection of the physical wetland boundary. The boundary should be delineated through biological, pedological and hydrological criteria. (Submission 10)***

***The boundary of the Marsh should be determined through biological, pedological and hydrological criteria (V & C Semeniuk Research Group, 2000). FMG should demonstrate that this has been done to assist in determining the true risk to the wetland from dewatering activities associated with mining. (Submission 7)***

Advice from CALM indicates that the boundaries of the Marsh have been determined using topographical data and reflect maximum recorded flood levels. CALM also advised that these boundaries, in some cases, extend beyond what might be seen locally as the Marsh and its constituent wetlands.

Despite this conservative position, and to ensure that FMG and its activities in the area do not impinge on the Marsh, a 400 m exclusion zone for any exploration activity has been determined outside of the ANCA flood boundary.

**4.2.10** ***When was DEH's peak flood boundary calculated? Should it be reviewed in light of climate change-related meteorological data? (Submission 8)***

***It is noted that no published flood level data are available for the Marsh. It is submitted that such data should be collected before this Project is further considered for environmental approvals. (Submission 8)***

Refer to responses 4.2.8 and 4.2.9.

**4.2.11** ***It is unclear how the Fortescue Marsh can be both 'predominantly' a surface water feature and also not at all dependent on groundwater recharge. In any event, this statement is not yet scientifically supported – nowhere near enough data and modelling has been done to justify the certainty with which the assertion is made. Has the modelling which has been done been peer reviewed? More work is required before the Project should be further considered for environmental approval. High value environmental assets cannot be put at risk on the basis of limited data. (Submission 8)***

The evidence that the Marsh is a surface water feature is strong. In particular, the groundwater below and adjacent to the Marsh is hypersaline, yet the water in the Marsh is fresh when ponding first occurs. Considerable data has been collected to show the relationship between the surface water in the Marsh and local groundwater. Approximately 70 bores have been monitored for water levels, a stage board has been installed in the Marsh, and water quality samples have been collected. These data, along with historic information have been collated and reviewed by expert hydrogeologists and hydrologists. The numerical model produced has been presented to the DoE (Water Investigations and Assessment Branch).

Nevertheless FMG recognises that, as with any other project, there is uncertainty. FMG has been pro-active in developed draft monitoring and management plans to ensure that, once mining commences, there is sufficient data available to monitor the current predictions and to mitigate in the unlikely event that these predictions prove to be at variance with the results of monitoring data. These plans will be reviewed by the relevant State Government agencies prior to licensing of the dewatering scheme.

**4.2.12** ***It is unreasonable for FMG to assert that groundwater drawdown will not extend below the Marsh until more monitoring and modelling of that system has been done. (Submission 8)***

The monitoring undertaken to date is extensive, and provides good regional data to support the model assumptions. Sensitivity analysis has been undertaken to understand the impacts of uncertainty on the results of the modelling. These results suggest that, within a reasonable range of assumptions, there is unlikely to be an impact on the Marsh.

As discussed above, FMG recognises that there is, as with any project, some uncertainty. Therefore, FMG has developed monitoring and management plans to monitor the accuracy of the predictions and provide appropriate management measures if an impact, currently unforseen, is later predicted to occur. Monitoring will occur between the Project and the Marsh to verify the predictions of the modelling. This will allow action to be taken in advance should unforseen adverse trends be observed.

**4.2.13** ***Not enough monitoring and modelling has been done to establish the "natural seasonal variation in groundwater levels". (Submission 8)***

FMG agrees that monitoring data is insufficient to account for seasonal variation in groundwater levels, which is why a robust model was used. FMG understands that the activities undertaken may not reflect the assumptions created from the model and have committed to ongoing monitoring and to update the model with these data. Any variations, and the implications for groundwater conditions and the Project, will be picked up early allowing for effective management of groundwater levels through the management plan. Further uncertainty and sensitivity analyses of the groundwater modelling will be conducted to make it more robust.

**4.2.14** ***The groundwater modelling, including dewatering schedules, predicts that groundwater levels will draw down close to, but not beneath the Fortescue Marsh. The modelled response is not sufficient to demonstrate conclusively that dewatering will not impact the Fortescue Marsh. The proponent must commit to an ongoing groundwater-monitoring programme to extend at least ten years after mine closure, until satisfactory recovery of the groundwater system is documented. Monitoring should include monitoring bores and revisions of the model based on data from the bores. (Submission 9)***

FMG has already commenced an extensive programme of borehole monitoring throughout the Project area. This monitoring will continue throughout the lifetime of the Project and on completion of mining. The length of monitoring after cessation of mining will be agreed between FMG and the relevant agencies. The scope of this monitoring will be agreed with the DoE prior to the licensing of the dewatering scheme and a detailed monitoring plan developed. The results of the monitoring programme will be reported to the DoE on an annual basis.

FMG has already agreed to the updating of the model annually based on the monitoring data collected from the bores.

**4.2.15** ***A comprehensive monitoring bore network, with appropriate triggers and responses defined, should be incorporated into the approvals for mining to proceed. This network should include sufficient monitoring to protect the marsh should the depressed groundwater levels encroach on the Marsh, which may occur after mining has finished. The cost of this monitoring could be incorporated in the DoIR rehabilitation bonds. (Submission 9)***

A range of trigger levels and associated management actions will be developed for each of the monitoring bores located between the pits and the Marsh. Because the cone of depression will radiate from the pits, it will be possible to monitor the development of the cone of depression in bores close to the pits, against these trigger levels, well before the cone approaches the Marsh. If an

observed water level close to the pit is lower than that which was predicted from the modelling, then this will enable FMG to implement the appropriate contingency plan to prevent any potential impacts to the Fortescue Marsh. Actions to form part of the contingency plan may include changes to mining sequences and schedules to reduce or cease dewatering in critical areas, re-injection of dewatering water, or alternative engineering controls to reduce inflow of groundwater into the pits

**4.2.16** ***Fortescue Metals Group needs to establish that no groundwater impacts will be seen on the Fortescue Marsh. Further drilling and monitoring are needed to confirm this. An adaptive groundwater management plan, incorporating triggers and responses, is necessary for approval of the mining operation. This is indicated in the PER and appendices, but needs to be formalised in the groundwater and environmental licensing of the Project. (Submission 9)***

FMG recognises that further work is required prior to licensing and has commenced some of these investigations. This work includes:

- Drilling and testing of further bores and modification of the groundwater model in the light of this data;
- Further sensitivity analysis and uncertainty analyses for the groundwater model; and
- Development of a dewatering plan that assesses the various options for disposal of abstracted water.

As stated in the submission, FMG has developed a draft groundwater management plan. This plan will be formalised prior to licensing of the Project in consultation with the relevant State Government agencies. Refer also to response 4.2.15.

## 4.3 SURFACE WATER

**4.3.1** ***It is unreasonable for FMG to suggest that "natural surface hydrology" is properly understood in such as boom / bust ecology as the Pilbara. More monitoring and modelling is required before the Project should be further considered for environmental approvals. (Submission 8)***

The infrastructure for iron ore and other mining projects in the Pilbara Region has been operating for over 50 years and over this period a substantial understanding of the region's surface water hydrology has been developed. In recent times, several large Pilbara mine sites requiring significant surface water management works have been successfully developed. Aquaterra has specific expertise in the investigation, environmental assessment, design and implementation of surface water flood control and diversion works for the mining industry and particularly in the Pilbara region. FMG appointed Aquaterra to provide guidance on the Cloud Break Project's surface water hydrology to utilise this extensive experience.

**4.3.2** ***The proponent needs to demonstrate that the mine pits can be rehabilitated and that natural surface flow regimes can be effectively restored. The significance of ephemeral creek systems (in terms of habitat and hydrology), the area of creek system disturbance, the proponent's ability to re-engineer and rehabilitate creek systems, and any long term management liabilities associated with their disturbance also need to be discussed. (Submission 10)***

During the mining process, as stated in the PER, it is proposed that the pit areas would be progressively backfilled to an extent dependent on the backfill material available. Upon completion of mining, FMG estimates that sufficient material would be available such that the pits could be backfilled to a level enabling the whole pit area to drain to the downstream environment. This would be achieved by backfilling the pits to a level above the lowest elevations on the down gradient pit perimeters and then ensuring that the finished pit surfaces are continuously draining to these areas. The backfilled pit surfaces would be finished with a layer of fine grained material and topsoil prior to rehabilitation such that surface water runoff from the backfilled pit area would drain to the downstream environment. When preparing the final surface over the backfilled pits, FMG propose to use compaction equipment to provide a smooth dense surface to encourage runoff as per the general predevelopment environment.

Where a significant creek system needs to be diverted by the mining activities, the physical characteristics of the creek will be recorded through the diversion zone. If the creek subsequently needs to be relocated over the backfilled pit areas, then the physical characteristics will be available as a guide for re-establishment. As the pits will be progressively backfilled, an opportunity exists to experiment with options to best recreate the predevelopment landform.

**4.3.3** ***The proponent should be required to clearly state its position on overburden management and backfilling mine pits, i.e. whether the mine pits will be completely backfilled (no void) or whether they will be partially backfilled to above the water table. (Submission 10)***

Section 5.3.2 of the Cloud Break PER states that the stripping ratio will range from 3.5:1 to 4.5:1 in the first six years, increasing to 6:1 in the later years. A bulking factor of 65% has been used for the overburden returned to the pits to determine the likely pit profiles. This figure has been estimated based on the geology and likely behaviour of the material and may change as more information is gathered during the mining process. Based on these calculations, it is FMG's intention to backfill mined out pits level to the surrounding landscape, and not to leave voids. The mine plan will be adjusted as mining proceeds to take account of any variation to the expected bulking factor but it remains FMG's intent to backfill pits.

**4.3.4** ***It is questioned why there is need for four permanent overburden landforms as shown in Figure 2. FMG should justify why these permanent landforms are required and not just that this is cost effective for their proposed mining. It is CALM's view that the most environmentally beneficial outcome is for only one small waste stockpile (if any) to be required containing overburden material from the first pit. (Submission 10)***

The permanent landforms will comprise the initial overburden and waste rock removed from the pits, prior to the commencement of backfilling. However, due to the distance between pits, it is not practical or feasible to transport the overburden removed from one pit to backfill another pit or deposit in another initial overburden landform. Any stockpiled waste rock remaining will be contoured and have topsoil and vegetation re-established to blend into the surrounding landscape. FMG does not believe that there is any significant environmental benefit to consolidating all waste into one large stockpile, as opposed to four smaller stockpiles.

**4.3.5** ***This Department suggests that additional information be sought from the proponent regarding the potential hydrological impacts caused by altering the geological and soil structure through mining. Given the predicted change in 'air space' by removing material during mining (known as the 'bulking factor'), there is potential that the backfilled pits will act as sinks for surface water. The proponent needs to demonstrate that the mine pits can be rehabilitated and that natural surface flow regimes can be effectively restored with no sheet flow shadow effects. (Submission 10)***

As stated in the PER, during the mining process it is proposed that the pit areas will be progressively backfilled. At Cloud Break this backfill material will consist of overburden and waste rock. It is proposed that the pits would be backfilled to a level above the lowest elevation on the pit perimeter and then ensuring that the finished pit surface is continuously draining to this area. The backfilled pit surface would be finished with a layer of fine grained material and topsoil prior to revegetation to encourage surface water runoff from the backfilled pit area to drain to the downstream environment.

The volume of surface water runoff draining from any surface depends on numerous factors including surface permeability, texture, depressions, topography, vegetation and rainfall characteristics. In the backfilled pit areas, some of these surface parameters are likely to vary from those occurring in the predevelopment environment. Hence, surface runoff from the corresponding surfaces will also likely vary.

When preparing the final surface over the backfilled pits, FMG propose to use compaction equipment to provide a smooth dense surface to encourage runoff as per the general predevelopment environment. Overall, it is estimated that surface runoff volumes directly from the backfilled pit surfaces would likely be similar or initially slightly lower than those from the predevelopment surface, due to the changed surface parameters. Any extra water initially absorbed by the backfilled pit surface would assist with vegetation regrowth over the pit areas. As the pits will be progressively backfilled, an opportunity exists to experiment with options to best recreate the predevelopment landform.

**4.3.6** ***If the proponent intends to disturb ephemeral creeks in the Project area, then it must clearly demonstrate that significant creek systems can be re-engineered and the final rehabilitated landscape can be made stable. Information should be provided on the long term stability of waste/overburden dumps, diversion structures and other stabilization measures. (Submission 10)***

Refer to 4.3.5.

Where a significant creek system needs to be diverted by the mining activities, the physical characteristics of the creek will be recorded through the diversion zone. When the creek needs to be relocated over the backfilled pit areas, then these physical characteristics will be available as a guide for re-establishment. As the pits will be progressively backfilled, an opportunity exists to experiment with options to best recreate the predevelopment landform.

**4.3.7** ***This Department requests that the proponent provides detailed discussion and maps on the proposed placement of temporary and any permanent overburden stockpiles. Evidence is required to support the proponent's statement that overburden placement areas will be established in the high elevation areas upstream from the open pits where drainage is characterised by defined creek flow paths. (Submission 10)***

CALM will be consulted during the detailed design phase. As mentioned in the PER, FMG will commit to locating overburden landforms in high elevation areas where possible. The proposed locations of overburden land forms have already been provided and are shown as Figure 2 in the PER.

**4.3.8** ***While we laud the objective of minimising impacts on natural drainage flows, we doubt that objective can actually be achieved in the context of large-scale strip mining. We understand that modelling and physical trials have been limited thus far, and the nature and scope of that work must be expanded before the Project should be further considered for environmental approvals. (Submission 8)***

See response to 4.3.1.

FMG recognises that although the proposed Cloud Break Project may alter the hydrological regimes at a local level, it is not expected to result in any significant reduction in surface water flows into the downstream Marsh.

**4.3.9** ***It is highly questionable that surface drainage patterns can be recreated after significant quantities of ore have been removed. When the submitter raised this issue during the site visit, it was argued that backfilling could achieve the same topography because of a bulking factor. This may be the case, but if so presumably the backfilled areas will be less dense than the rocks and soil they replace, and therefore potentially absorbing much more water and not allowing sheet flow in a comparable way to the pre-mining landscape. Will the less dense backfilled material therefore be more porous and thus damaging to sheet flow? (Submission 8)***

During the mining process, as stated in the PER, it is proposed that the pit areas will be progressively backfilled to an extent dependent on the backfill material available. Upon completion of mining the pits will be backfilled such that the whole pit area can drain to the downstream environment. This would be achieved by backfilling the pit to a level above the lowest elevation on the pit perimeter and then ensuring that the finished pit surface is continuously draining to this area. The backfilled pit surface would be finished with a layer of fine grained material and topsoil prior to revegetation to encourage surface water runoff from the backfilled pit area to drain to the downstream environment.

See response to 4.3.5 for further discussion of this issue.

**4.3.10** ***There is no discussion of final changes to landscape, nor figures (e.g. cross-section,***

***conceptual topography after mining) of areas that will be mined containing the deeper deposits (pits to 70 m) after the total projected resource of 500-600 Mt of ore has been removed. Although management strategies for surface-water flow are discussed for both construction and mining, there is no discussion of final landscape features, its projected impacts on surface water flow, and management strategies to ensure environmental and landscape values are maintained. (Submission 4)***

As outlined in Section 6.5.2 of the PER, FMG will endeavour to create similar landforms to that present prior to mining, although it is acknowledged that some localised changes in drainage patterns will occur (refer to response 4.3.11). FMG provided detail on the future closure and rehabilitation of the proposed mine sites in the Conceptual Mine Closure Plan in Appendix M of the Cloud Break PER. The development and submission of this Conceptual Closure Plan will facilitate public involvement in the closure process from the early stages of the Project.

FMG has committed to developing a Life of Mine Closure Plan within two years of commencement of mining activities. This Plan will be updated during the life of the mine. A final closure plan will developed at least two years prior to the scheduled closure of the operations. Specific completion criteria developed through the closure planning process will establish a set of environmental indicators that upon being met will ensure successful rehabilitation of the site. FMG views consideration of topography and surface drainage as key issues in achieving a successful rehabilitation outcome.

**4.3.11** ***The proposed mechanisms for distributing surface water sheet flow downstream of Project infrastructure need to be regularly inspected and maintained over the life of the mine (p. 89). (Submission 10)***

FMG will incorporate the inspections of the culverts and redistribution systems into the rail inspection programme. Additionally, culverts and redistribution systems will be checked immediately following rainfall events. These requirements are expected to from part of the Ministerial conditions for Stage B and will also be adopted for the Cloud Break Project.

**4.3.12** ***The Region has concerns relating to the effectiveness of the proposed engineering solutions to redistribute diverted sheet flow. Furthermore the Region is concerned that the proponent has not made sufficient commitment to the management and monitoring of the effectiveness of such structures especially the ongoing maintenance of the structures required to render them effective. (Submission 7)***

Structures proposed to be utilised for redistributing sheet flow have been trialled by C Muller Consulting. The first trial (presented as Appendix F of the Stage B PER) tested the effectiveness of spreader ditches and levee banks for redistributing sheet flow after constriction at a culvert. This trial strongly indicated that levee banks were the most effective solution.

The first trial recommended that further work be conducted into the comparative effectiveness of a range of graded crushed rock materials and the effect of sediment loads on performance over time. The second trial (Appendix A of this document) examined the effects on size distribution of rock structures, sedimentation, and flow rate on the rate of infiltration and spread of water. This trial found that:

- Rocks with a nominal screened size of 75-120 mm provided the best results against the assigned criteria;
- The effectiveness and longevity of a levee could be increased by putting a rock armoured spreader ditch before it;
- Sediment deposit from reducing velocity of water did not catastrophically block voids in the levee structure; and
- The levee design could withstand the maximum possible flow from culvert design.

FMG believes that the two trials conducted supply sufficient information to design an effective system for sheet flow redistribution and are confident with the results presented by C Muller Consulting. However, FMG understands that the situation in practice does not always match trial conditions. Consequently, FMG has committed to, as part of its Stage A and B conditions, to develop a Rail Corridor Management Plan that will include an ongoing monitoring programme of culverts and redistribution structures. The Plan will allow for monitoring of the condition of the redistribution system and ongoing maintenance and monitoring of the condition of vegetation downstream.

**4.3.13** ***Why will surface water be diverted into nearby defined surface water pathways? In all cases the goal should be to divert water around obstacles such as pits such that it joins existing downstream flow pathways (noting of course that we do not believe enough modelling has been done to show that this is possible). Where surface water diversion is not successful, what are the management measures proposed for dealing with shadow effects on mulga groves? (Submission 8)***

The Aquaterra Surface Hydrology Report for the Cloud Break PER (Cloud Break PER Appendix B) states that surface water protection bunding will be constructed around the pit perimeters and waste areas, comprising a combination of bunding and diversion channels, to prevent external surface water from entering the work areas. Upstream surface water flows will be diverted around the development areas and directed into adjacent defined surface water pathways. Where adjacent defined surface water flow pathways are not present, diverted water will be directed around the development areas to join existing flow pathways located downstream. Where sheet flow zones are located immediately downstream from the pit areas, diverted surface water will be discharged over a riprap (rock fill) pad to encourage the flows to slow and disperse.

Where due to topography, diversion of upstream surface water runoff around the pit perimeter is not feasible, the external runoff water will be ponded against external bunds and removed by pumping or allowed to dissipate by evaporation and seepage. Alternatively, the upstream surface water runoff will be allowed to discharge into the pit area (within engineering safety constraints). In-pit sumps and pumps will be designed to manage any external surface water entering the pit, together with in-pit stormwater volumes. To save on water abstractions from the water supply bores, it is proposed that the in-pit water will be primarily used for dust suppression or process water for the Stage B beneficiation plant. However, prior to pumping from the pit, the in-pit water will be treated via sediment ponds.

Where a sheet flow zone containing a grove/intergrove mulga community is located immediately downslope from an open pit area and external surface water runoff is collected in the pit, it is proposed that some of the collected in-pit water will be used to irrigate this sheet flow zone. However, as sheet flow only occurs following a major rainfall event, this irrigation system will only be used following such an event. The proposed irrigation system will comprise a separate mobile pump

feeding water to a movable spreader pipework system. Irrigation will not be applied to grove/intergrove areas that are approved to be cleared by future mining activities.

**4.3.14** ***Need to ensure that all backfilled pit areas are such that they will drain to the downstream environment. Do not want pits being left with lower elevations that result in water pooling and not being able to drain downstream. (Submission 2)***

During the mining process, FMG has proposed that the pit areas will all be progressively backfilled above the watertable. Upon completion of mining, if sufficient material is available, the pits will be backfilled such that a whole pit area can drain to the downstream environment. This would be achieved by backfilling the pit to a level above the lowest elevation on the pit perimeter and then ensuring that the finished pit surface is continuously draining to this area. The backfilled pit surface will be finished with a layer of fine grained material and topsoil prior to rehabilitation such that surface water runoff from the backfilled pit area will drain to the downstream environment. Some portions of the pits may be preferentially backfilled during the mining process, to enable upstream (external) surface water runoff to pass through the pit area, rather than be diverted around the pit footprint (within engineering safety constraints).

**4.3.15** ***Would like to see adequate provisions for bunding and onsite drainage works to protect nearby Fortescue Marsh from runoff that may result from ore moisture control and dust suppression activities generated onsite. (Submission 2)***

FMG will bund all infrastructure areas as appropriate to retain internal drainage. The internal drainage will be collected and reused for dust suppression.

Ore stockpiles will be established at train loading facilities in the rail corridor. FMG will also bund these stockpile areas, to contain internal drainage and protect from any external surface water runoff. Water collected from within the bunded areas will be used for dust suppression or as process water for the Stage B beneficiation plant. It is considered that the stockpiles will have no impact on the surface water runoff quality in the downstream environment, due to the perimeter bunding and retention of the internal drainage waters.

FMG propose to construct surface water protection bunding around the waste area perimeters, as appropriate. These protection works, comprising a combination of earth bunds and diversion channels, will prevent external surface water from entering the active waste rock areas. Upstream surface water flows will be diverted around the waste areas, where feasible and directed into defined surface water pathways either adjacent or downstream from the waste areas. Riprap pads will be provided in key areas along the edges of the diversion bunding to slow and redistribute runoff. Within the waste areas, surface water runoff will be drained from the waste area top surface and batters to the downslope sides and then directed through sediment basins, to reduce sediment loadings and turbidity, prior to discharging to the downstream environment. All surface water collection sumps will be designed for flood events. However, due to the high evaporation rate in the Pilbara it is not expected that there would be any runoff generated from ore moisture control and dust suppression.

**4.3.16** ***There is little information regarding the sediment load of rivers of the Pilbara region (Mark Pearcey, pers comm., Senior Hydrologist Water and Rivers Commission). The Region emphasises the need for an appropriate management and monitoring programme to be put in place focusing on minimising the turbidity of water leaving the site and entering the Marsh to ensure there is no impact to the Marsh. (Submission 7)***

FMG recognises that the limited information on sediment and turbidity loadings in the Pilbara Region water courses is predominantly due to the practical issues associated with obtaining representative samples from the water courses. These issues include the remote nature of the area, infrequent discharge occurrences, access during wet periods, representative sampling procedures and the short periods during which the smaller creeks flow.

During a runoff event, the Pilbara creek systems discharge water with naturally high turbidity and sediment loads (WRC, 2000). Rainfall impact and surface water runoff naturally shape the landscape with general erosion in upper portions of the catchments and deposition (sedimentation) in the lower portions. During the infrequent high (cyclonic) rainfall events, these natural processes are accentuated with higher sediment and turbidity loadings in the creek systems.

As stated in the PER, FMG expects that in proximity to the pits, diverted flows may experience some increase to their naturally high sediment and turbidity loadings. However, these potentially elevated levels will dissipate with distance from the pit area and the measures described in the response to 4.3.15 are expected to limit sediment and turbidity. The Fortescue Marsh is approximately 3.0 km from the Cloud Break Project area at its nearest point. The potential impact of runoff water quality draining to the Marsh from the external diversion works at Cloud Break and other sites, in particular sediment loadings and turbidity, is considered insignificant due to the distances between the pit development areas and the marsh, and the proposed management measures.

As part of the Environmental Management Plan (EMP), FMG will undertake to work with the DoE to establish a representative water turbidity/sediment monitoring site on a water course downstream from the Cloud Break Project area prior to water entry to the Marsh.

**4.3.17** ***Need to include bunding and drainage provisions for the initial overburden placement areas and initial rejects placement areas. We feel there is a need for more in place than just contouring to secure the overburden/rejects particularly under heavy rainfall events. (Submission 2)***

Within the overburden placement areas, surface water runoff will be drained from the top surface and batters to the downslope sides and then directed through sediment basins prior to discharging to the downstream environment. Surface water protection bunding will typically be constructed around the perimeter of these areas including around the sediment ponds. These protection works, comprising a combination of earth bunds and diversion channels, will prevent external surface water from entering the sediment-prone overburden placement areas.

No initial rejects placement areas will be required as part of the Cloud Break Project. Refer to the Stage B PER for management of surface water from the Stage B reject placement areas.

**4.3.18** ***In terms of flood effects and their management, would like to see emphasis on identifying 100 year flood level and ensuring that there is containment of any mine***

***waste/discharge above that determined level. Where sumps are being used, need to ensure that they are capable of withstanding flooding events and are located in an appropriate area in accordance with expected flood events. (Submission 2)***

The Fortescue Marsh is an extensive intermittent wetland occupying an area around 100 km long by typically 10 km wide located on the floor of the Fortescue Valley. As stated in the PER, published topographical mapping indicates that bed levels in the Fortescue Marsh predominantly lie between 400 m and 405 m above sea level. Based on internal WRC records, the flood storage level in the Marsh would need to be over 413 m above sea level to overspill westwards past the Goodiadarrie Hills. Although no published flood level data are available for the marsh, WRC internal records show a marsh flood level near the BHPBIO railway of around 406.5 m above sea level in March 1980 resulting from consecutive cyclones Dean and Enid. Enquires with BHPBIO indicate that flood levels have never overtopped their railway crossing over the Marsh, although large floods in the early 1970s are reported to have caused inundation up to the existing railway track level (pers. comm. Geoff Liddell, BHPBIO).

To fill the Marsh to overspill level (413 m above sea level), it is estimated that a flood event well in excess of the 100 year ARI (average recurrence interval) would be required. The proposed Cloud Break mine development has pit perimeter levels of around 415 m to 450 m above sea level and is therefore well above any recorded flood storage level in the Marsh and above the overspill level for the Marsh. All FMG pit development and waste storage works will be located above the 100 year ARI flood level in the Marsh.

**4.3.19** ***The review of the PER identified that FMG has not adequately considered high rainfall events in the design of the mine. High rainfall events associated with cyclonic weather conditions have the potential to cause wide scale erosion and inundation of the Project, This may lead to unauthorised discharges of hydrocarbons and other environmentally damaging compounds. The proponent must consider extreme rainfall events in all aspects of the design of the Project. (Submission 7)***

Surface water protection bunding will be constructed around the pit and waste area perimeters, as described in the PER. These will comprise a combination of bunding and diversion channels, to prevent external surface water from entering the disturbed areas. During the Project detailed design stage, the layouts and dimensions for these works will be defined taking into account the infrequent high (cyclonic) rainfall events. Areas used for storing hydrocarbons products will be bunded to industry standards and will take into account the potential for extreme rainfall events.

**4.3.20** ***The clearing of the Mulga in the Valley will lead to increased rates of erosion of silts and clay, increasing the potential for siltation of the Marsh downstream. The PER does not address the potential for flooding or how potential impacts would be addressed. There is no discussion of flood events (history) or management / impacts on the mining area of a 1 in 100-year event. (Submission 4)***

FMG has recognised the potential for clearing and the subsequent establishment of the mines and supporting infrastructure to affect surface water movement and potentially lead to increased erosion and sedimentation. FMG has outlined a number of strategies in Sections 6.2.2, 6.2.3 and 6.5 of the Cloud Break PER to minimise the impacts of the Project area. These include but are not limited to:

- sediment traps;
- rip rap pads to diffuse water flows; and
- diversion of water flows.

Refer also to responses to question 4.3.18 and 4.3.19.

## 4.4 SHEET FLOW AND MULGA WOODLANDS

### 4.4.1 *No quantitative data is available to define the upstream catchment area (or sheet-flow) required to sustain the Mulga communities (p.75). (Submission 4)*

Whilst it is acknowledged that no quantitative data is available to define the upstream catchment area required to sustain mulga, the Cloud Break active open pit areas (475 ha) represent a very small percentage of the total catchment area (0.02%). When the Cloud Break Project and FMG's other mining areas within the Fortescue River Catchment (Christmas Creek and Mindy Mindy) are considered, the potential cumulative impacts are still not expected to be significant. Assuming concurrent mining at both locations, and that open pits totalling 925 ha are active at any one time, the area of total catchment not available for surface water runoff will not exceed 0.03% of the catchment. These are considered conservative estimates as FMG would minimise the total area open to active mining at any one time, and divert where practicable, surface water flows from upstream of the Project into adjacent surface water pathways or, existing downstream flow pathways.

FMG has conducted a number of field trials into maintaining sheet flow in sensitive areas such as mulga woodlands. Further test work has recently been completed at Woodie Woodie to assist in the engineering design of structures to spread sheet flow. This has been included as Appendix A.

To complement the above research FMG will also conduct an internal research project on Mulga plant-water relationships as an offset (refer to Section 3). This Project will aim to gain further knowledge on the extent of dependence of Mulga on sheet flow for survival. The Project will be ongoing for at least five years and will be scoped and managed internally by FMG personnel with advice from CALM and academic experts in this field.

FMG notes that work undertaken for Stage B (see Section 6.1.4 of the Stage B PER) found that Mulga groves are generally dependent on runoff from the intergrove upslope. This suggests that water shadow would not extend far beyond one grove-intergrove stand of Mulga downstream of a surface flow barrier.

### 4.4.2 *There is no detailed information available on the degree to which mulga groves and intergroves depend on current surface drainage patterns, and the impacts the proposed mine will have on these patterns. (Submission 10)*

*There is little information available on the workings of how mulga satisfy their water needs from surface flow sources, and this is felt to be an area that needs extensive study and investigation before and it is felt inadequate that such study take place during and after such dramatic modifications has taken place in the area. (Submission 2)*

As stated in the PER, the main surface water impact from the proposed Cloud Break mine development would be interruption to the existing surface water flow patterns and a potential reduction of surface water runoff volume and quality in the downstream environment. In particular, grove/intergrove mulga communities, which are partially dependent on sheet flow runoff and may potentially be impacted. These communities are spread through the general Project area with their main concentrations on the lower flanks of the Chichester and Hamersley Ranges adjacent to the Fortescue Marsh.

Grove/intergrove mulga communities are reported to be dependent on both direct rainfall and sheet flow for providing soil moisture and nutrients for stability and productivity (Anderson and Hodgkinson, 1997). To determine the extent that grove/intergrove mulga communities are dependent on sheet flow and their potential to be impacted by interruption to sheet flow runoff, assistance was sought from both the Mulga Research Centre at the Department of Environmental Biology at the Curtin University of Technology and the Ecosystem Research Group at the School of Plant Biology at the University of Western Australia. These research establishments have undertaken extensive investigations and are familiar with other Australian research into various aspects of the mulga communities. Based on discussions, numerous factors affect the ecology of the grove/intergrove mulga communities, but no quantitative data is available as to the upstream catchment area required to sustain the communities or the extent of their dependence on surface water flow.

Given the limited knowledge of the mulga community dependence on upstream sheet flows, FMG will conduct an internal research Project, on Mulga plant-water relationships as an offset (Stage B). This Project will aim to gain further knowledge on the extent of dependence of Mulga on sheet flow for survival. The Project will be ongoing for at least five years and will be scoped and managed internally by FMG personnel with advice from CALM and academic experts in this field.

The findings of the research work will be used to adjust FMG's proposed approach to managing sheet flow zones immediately downstream from the Project. In this situation diverted surface water will be discharged over spreader mechanisms to encourage the flows to slow and disperse. The design and operation of the spreader mechanisms has been determined through trials conducted by C Muller Consulting whose reports are included in the Stage B PER (Appendix F) and in Appendix A of this report.

**4.4.3** ***Given the lack of information on how the mulga communities will respond to the changes in hydrology over time, the proponent should develop a mulga monitoring programme. It is uncertain how effective a monitoring programme for the health of mulga communities will be in accurately determining whether or not changes to surface and groundwater hydrology are having an impact over time. Pilbara Iron is currently monitoring mulga communities at the West Angeles mine via remote sensing. The proponent could consider reviewing that programme and establish a similar regime. (Submission 10)***

FMG will adopt the relevant Ministerial Conditions set for Stage B throughout its Project areas including Cloud Break. These conditions require FMG to develop and implement a Mulga and Other Flora and Communities Management Plan and would include the following aspects:

- monitoring and reporting of impacts on vegetation communities including Declared Rare Flora and Priority flora species, Mulga and restricted plant communities within the Project area;

- any targeted regional surveys which are required prior to ground disturbance;
- activities to provide further information on the conservation and baseline values status of each of the species and/or communities;
- any regeneration or revegetation strategies which are required for species and/or communities, including completion criteria to be met following the survey for species and/or communities impacted by the Project;
- any management or mitigation actions required to address any failure to achieve regeneration completion criteria; and
- any further investigations into the regeneration and seed ecology of affected species or communities in order to determine appropriate regeneration methodologies, if completion criteria are not being achieved.

FMG recognises that remote sensing can be used in conjunction with other methods as a monitoring function. FMG will consider this as an option for monitoring during the development of the Mulga and Other Flora and Communities Management Plan.

**4.4.4** ***Given the potential impacts on mulga communities due to land clearing and the proposed alterations to surface and ground hydrology by both Cloud Break and Stage B proposals, it is recommended that FMG commit to undertaking research into the taxonomy and conservation status of mulga in the Fortescue Catchment. (Submission 10)***

FMG has already committed to undertaking research into the ecology and/or taxonomy of Mulga in the East Pilbara as part of the offset package for Stage B (Section 3.1). This programme would be aimed at further understanding and protecting the conservation values of the Chichester footslopes Mulga woodlands.

## 4.5 GROUNDWATER

**4.5.1** ***Concern over the amount of water to be taken from the local dedicated borefield and concern this may have on depressing the aquifer level as a whole and rise of salts in the profile. Particularly in relation to how this may affect Fortescue Marsh. (Submission 2).***

The dedicated borefield is required for the Stage B Project, not the Cloud Break Project. Since submitting the Stage B PER, a considerable amount of work has been undertaken to determine the impacts of this borefield on the Marsh. The information was provided as part of the responses to Submissions for the Stage B assessment.

As discussed in the Cloud Break PER it is expected that water supply for the Cloud Break Project will largely come from dewatering and would be used for dust suppression and for potable water. A Reverse Osmosis plant may also be required if dewatering water is not of sufficient quality for potable water uses. With respect to the impact on the Fortescue Marsh, it is believed the Marsh is predominantly a surface water feature. Responses to submissions in section 4.2 of this report provide more information on this issue.

**4.5.2** ***Concerns over the effects to the vegetation communities that are dependent on groundwater for survival, if there is unmanaged drawdown. Would like to see an***

***appropriate management plan introduced that combines monitoring of the levels of drawdown on a biannual basis (to ensure that drawdown follows that which has already been predicted) and management measures that act to minimise the negative effect substantial drawdown may have on dependent vegetation communities (in effect making sure the drawdown does not get to a stage where it threatens the survival of such communities). (Submission 2)***

FMG currently undertakes groundwater monitoring of 68 bores on a monthly basis, and proposes to continue monitoring at this frequency for the duration of mining. FMG has developed a Borefield and Dewatering Management Plan, which includes details of vegetation monitoring which will be undertaken prior to and during dewatering and mining. FMG will implement preventative measures if monitoring and model predictions indicate that phreatophytic vegetation is likely to be affected by dewatering. Refer to 4.2.15 for discussion about groundwater trigger levels and contingency measures.

**4.5.3** ***There is concern over potential for a rise of saline groundwater and any overlying vegetation communities that could be affected. Would like to see a monitoring programme to ensure the saline water rise is monitored and kept at a level that will not negatively effect the above lying vegetation. Would like to ensure that in no circumstances is saline water abstracted. (Submission 2)***

FMG is aware of the possibility of saline water rise, although there is no evidence to suggest that it could affect phreatophytic vegetation. The concerns relate to potential decreases in water quality in station bores. There is an existing monitoring programme which includes monthly water quality monitoring and down-hole geophysical logging of bores between the Marsh and the pits. This data is being collated and analysed to understand more thoroughly the existing distribution of saline water in the area. During the mining phase FMG is committed to continuing to build on the monitoring programme currently in place. The details of this monitoring will be agreed with the relevant agencies prior to licensing and the data will be submitted to the DoE annually.

FMG recognises that if saline water were abstracted, its disposal could result in considerable additional capital expenditure and management. It is in FMG's interests to minimise the risk of saline water being abstracted. This is one of the key reasons why FMG is investing in a detailed water quality monitoring programme.

**4.5.4** ***There is concern about the management of excess water obtained from dewatering and is supportive of the DoE being involved in the development of a suitable monitoring programme including management of sediment/turbidity and dissolved salts. Any disposal option selected must have minimal negative impact on the environment into which it is being discharged, particularly Fortescue Marsh. (Submission 2)***

FMG's preference is to store water abstracted during dewatering for subsequent use in the Stage B beneficiation plant. This will minimise the overall abstraction at the Mount Lewin borefield (Stage B PER report). FMG is committed to working with the DoE on the preferred method of management of the excess water and to ensuring that adequate monitoring is in place. This monitoring will be included in the Borefield and Dewatering Management Plan with results submitted to the DoE annually.

FMG has no plans to dispose excess water through discharge to the environment or directly to the Fortescue Marsh.

**4.5.5** ***Dewatering will produce excess water that will be stored in ponds for use in the ore-beneficiation process. How will the water be transported to Christmas Creek? (Submission 4)***

It is anticipated that the water will be transported to Christmas Creek by pipeline.

**4.5.6** ***The PER states "The options for aquifer re-injection and in-pit disposal will be investigated further (p.xv). We believe investigations should be completed and reviewed as part of the environmental review process. (Submission 4)***

FMG has conducted an assessment of the options available to manage excess water and believes that the proposed solution of storing water in temporary ponds constructed within future pit outlines, for subsequent use in the Stage B beneficiation plant, has the least environmental impact and is therefore FMG's preferred solution. However, FMG will continue to review options for managing excess water from dewatering activities. This will include examining options such as aquifer re-injection to determine if they are technically feasible, and if they could be more environmentally acceptable than storage.

**4.5.7** ***We have grave concerns about the impact of the Cloud Break Project on the station's water supply. These concerns have not adequately been addressed in the Cloud Break PER. The PER does not identify which bores are likely to be affected nor proposes a strategy for pastoralists to be ensured of a continuous water supply. (Submission 5)***

The bores that may be affected lie between the Fortescue Marsh and the Cloud Break deposit. Water level monitoring and water quality monitoring is being undertaken at these bores on a monthly basis and down-hole geophysical investigations have been undertaken at some locations where access is possible.

It is proposed that the water quality and water levels in these bores will continue to be monitored monthly throughout the life of the Project. The data from the monitoring will be incorporated into the existing numerical model, to update model predictions of the potential impacts to station bores. These predictions will be used to develop contingency measures well in advance of any bore becoming unusable. The data from the monitoring will be made available to the DoE and station owners.

**4.5.8** ***The Cloud Break PER also indicates that, in addition to the potential for yields from station bores to be reduced, there is a likelihood that station bores will be contaminated by saline water unless the water drawn down from the Cloud Break Project is effectively managed. (Submission 5)***

As discussed in Section 4.5.7 of the PER, FMG has agreed to the ongoing monitoring of water quality and water levels in station bores between the Fortescue Marsh and the Cloud Break deposit.

FMG has developed a draft dewatering management plan, the key elements of which will be

incorporated into licences to be issued by the DoE, and which will be regularly reviewed. In the event that water quality declines appreciably in station bores, FMG will act to restore supplies to an acceptable quality or provide an alternative source.

**4.5.9** ***The environmental management strategy proposed by FMG is for affected station bores to be deepened or alternative water supply provided from FMG's Project bores… The PER advises that monitoring of several station bores has commenced in the vicinity of the Project, however these bores are not identified. (Submission 5)***

The station bores currently being monitored in the Cloud Break area can be seen in Figures 12 and 13 of the Cloud Break PER and include the following bores:

- Mulga Bore
- Cook's Bore
- Minga Well
- Moojari Bore

In addition, FMG is also monitoring water levels in Condinna Pool and several bores drilled specifically for the Project.

**4.5.10** ***Further, FMG's proposal of deepening station bores will only be implemented after station bores have been affected. This combined with the construction of deeper wells will result in unacceptable risks to station cattle stock. (Submission 5)***

FMG will use the monitoring data and numerical model to predict water quality impacts before a station bore is affected by saline water intrusion. This will be done in a timely way to ensure that replacement water supplies are made available prior to the water quality declining and becoming less suitable for cattle.

**4.5.11** ***The FMG Stage B PER identifies that groundwater impact assessment incorporates the dewatering of the Chichester Mines and supply from a borefield. These mines include the Christmas Creek, Mt Nicholas and Mt Lewin mines. The FMG Cloud Break PER outlines that the total FMG Stage B Project water demand will not be required until after year 6. However as outlined above the Cloud Break PER specifically excludes the Mt Nicholas and Mt Lewin Mines. This discrepancy creates uncertainty about the nature, volume and location of water extraction and raises questions about the validity of the hydrogeological modelling and impact assessment in both the Cloud Break and Stage B PERs. (Submission 6)***

The Stage B Project has been revised so that mining at Mt Nicholas and Mt Lewin is no longer a part of the current assessment. A summary of the revised Stages A and B Projects and the Cloud Break Project is presented in Appendix B. The revised Stage B Project includes a reduction in water requirements from 11 GLpa to 8 GLpa.

The majority of the water requirements for Stage B will still be for beneficiation of ore, and the same total 45 Mtpa throughput of ore in the beneficiation plant (and therefore the same water requirement for this component) is proposed. However, the ore will be provided from Christmas Creek and Cloud Break mines, rather than include Mt Nicholas and Mt Lewin mines as originally proposed. Process

water will therefore not be supplemented by dewatering water from Mt Nicholas and Mt Lewin mines. At Cloud Break, water will only be required for dust suppression and for potable water use, and this will be supplied by dewatering.

There will be an excess of approximately 6 GL of water from Cloud Break at the end of year 6 which will be transported to Christmas Creek to use in the beneficiation plant. Ongoing dewatering at Cloud Break will also continue to supply water for dust suppression and supplementary water for the beneficiation plant to reduce the water requirements from the Mt Lewin borefield.

**4.5.12** ***The models presented in the PER were based on less information and investigation than the Water Investigation and Assessment Branch (WIAB) require to make an adequate risk assessment of the Project. The proponent will be required to undertake further investigations prior to groundwater abstraction licences been issued. (Submission 7)***

The Cloud Break PER includes a draft programme of additional work (Section 9.2 of Appendix C, and 4.2.16 in this report) to be completed prior to licence applications being made. This programme of work includes proposals for further testing and modelling, which FMG accepts will be required. Details of this programme will be discussed with the DoE. However, the existing information is considered sufficient for the assessment of the PER.

**4.5.13** ***The Region does not support the construction of the three square kilometres of storage ponds to store dewatering discharge. The Region supports the re-injection of dewatering water. The Region therefore recommends that the EPA require FMG to undertake further feasibility studies into reinjecting dewatering water from the Cloud Break Project. (Submission 7)***

***The proponent's preference to manage excess groundwater from dewatering is storage in exposed ponds. This is not regarded as best management practice. (Submission 10)***

FMG and its consultants (Aquaterra) believe the use of storage ponds for collecting water from the dewatering process is a beneficial outcome. The ponds will be located in areas that will subsequently be stripped for mining, so there is no additional habitat disturbance. Furthermore, the storage of water will mean less abstraction from the Mount Lewin Borefield. Within the Cloud Break PER, FMG has committed to undertaking work to determine the feasibility of aquifer re-injection (and other disposal methods), but the results so far suggest that this is not an option because of the lack of a suitable receiving aquifer. FMG will complete the results of its modelling, to determine if there is a suitable aquifer, and provide a copy of the report to the relevant agencies. If re-injection is shown to be feasible and more environmentally acceptable, then FMG will consider it as an alternative to storage.

**4.5.14** ***Storage ponds in the vicinity of the Fortescue Marsh will provide an artificial habitat for avian and aquatic fauna. The artificial water body may change the natural behaviour, breeding and population dynamics of avian fauna frequenting the Fortescue Marsh. (Submission 10)***

If necessary, FMG will discourage avian fauna from utilising these ponds through the use of deterrents such as propane cannons.

**4.5.15** ***What management measures will be undertaken if phreatophytic vegetation deteriorates more than seasonal variations would cause? It seems that "evasive action" is only proposed for impacts on station bores. (Submission 8)***

As stated on page 99 of the PER, FMG will develop a Vegetation Monitoring and Management Programme (as part of the Borefield and Dewatering Management Plan) to ensure that impacts on phreatophytic vegetation will be appropriately managed. The Plan will be developed with advice from CALM and specialist plant physiologists. Measures will include but not be limited to:

- the establishment of permanent vegetation monitoring plots;
- the construction of groundwater bores to monitor water levels in the alluvial and basement aquifers along creeks where vegetation might be effected, prior to commencement of abstraction;
- sampling of groundwater in the vicinity of Cloud Break to monitor changes in salinity of the alluvial aquifer during dewatering;
- development of improved numerical groundwater models and annual calibration of these models, so that future drawdowns, for the life of the Project, can be identified in a timely manner before potential impacts occur;
- assessment of vegetation condition in groundwater drawdown areas (commencing prior to abstraction); and
- if groundwater monitoring and vegetation condition assessments indicate a decline in condition due to drawdown, consideration of irrigation systems to support selected communities outside the proposed mining areas.

The results of vegetation monitoring within the groundwater drawdown zone will be reported in the Annual Environmental Report, which is submitted to the DoE and the Department of Industry and Resources (DoIR).

**4.5.16** ***There is no detailed evaluation of how long-term groundwater drawdown will affect the health and survival of groundwater-dependent vegetation in the entire area that is currently reliant on natural seasonal fluctuations. (Submission 10)***

The expected groundwater drawdowns have been modelled and plotted against vegetation mapping (Figures 16a-c of the PER). Those vegetation communities believed to include vegetation with some degree of groundwater dependency are outlined in section 6.2.7 of the PER. There is, however, very limited quantitative information on the relative importance of groundwater compared to soil water. Comment on this is provided by Hatton and Evans (1998) who say "methods for assessing the dependence of ecosystems on groundwater are largely indirect, or based on the (reasonable) assumption that groundwater use by plants and animals is prima facie evidence of dependence. Few, if any, in situ, controlled and replicated manipulative experiments have ever been performed in this

regard". The monitoring programme that will be outlined in the Borefield and Dewatering Management Plan offers the opportunity to improve understanding of groundwater dependency in the vegetation communities at Cloud Break.

**4.5.17** ***The impacts of groundwater drawdown on the Fortescue Marsh and groundwater-dependent vegetation are not adequately avoided and/or managed. (Submission 10)***

Dewatering of the pits is necessary to mine the ore. FMG is taking all reasonable approaches to minimise the amount of dewatering and environmental impact. In particular, it is proposing to use sumps to collect water from the seepage face, rather than construct dewatering bores which will produce a larger cone of depression.

FMG has developed a draft Borefield and Dewatering Management Plan to monitor the movement of the cone of groundwater depression. This management plan includes a vegetation monitoring and management programme. FMG has committed in that programme to collect monthly data to monitor groundwater levels and salinity and model the data so that potential environmental impacts can be identified before they occur. In the event of such an impact being predicted, appropriate mitigation measures will be implemented in a timely manner. A range of mitigation measures have been identified which include undertaking trials to determine the effectiveness of irrigation systems on phreatophytic vegetation. Other contingency measures may include changes to mining sequences and schedules to reduce or cease dewatering in critical areas; re-injection of dewatering water; or alternative engineering controls to reduce inflow of groundwater into the pits (see response 4.2.3).

**4.5.18** ***The potential impact of groundwater drawdown on phreatophytic vegetation is largely underestimated in the PER. The proponent's modelling suggests that the predicted groundwater drawdown outside the mining area is within the seasonal fluctuation (i.e. between 0.5 m and 5 m) and hence it is considered unlikely that there will be significant impacts on phreatophytic species (p. 80). There is no discussion on the duration of groundwater drawdown as a consequence of proposed mining or the associated impact on vegetation, and therefore there is no capacity to assess the veracity of this claim. (Submission 10)***

The likely impact on phreatophytic vegetation has been assessed based on the available knowledge of species believed to be groundwater-dependent or partially groundwater-dependent, and of the expected changes to groundwater occurring as a result of FMG's operations (see section 6.2.7 of the PER). On the available evidence, adverse impacts are not anticipated. However, FMG has committed to the preparation and implementation of a Borefield and Dewatering Management Plan that will include a monitoring programme for vegetation believed to be groundwater-dependent. FMG will consult with CALM in the formulation of this Plan. The Plan will be prepared and implemented prior to the commencement of dewatering, and will address potential contingency measures that can be implemented in the event that adverse impacts occur or appear likely to occur.

**4.5.19** ***The proponent needs to demonstrate that it understands 'which' species, other than samphire (p. 80), and 'how many' of these species will potentially be impacted by extended periods of dewatering. (Submission 10)***

FMG's understanding of which species are likely to have some degree of groundwater dependency is outlined in section 6.2.7 of the PER and identified in the vegetation reports prepared by Mattiske (2005) and Biota (2004). The vegetation monitoring programme proposed as part of the Borefield and Dewatering Management Plan will provide a guide to the vulnerability of individual species to changes in groundwater regimes and the potential extent of impacts. Indeed, the Plan can be modified during the life of the Cloud Break operation to take account of individual species responses and to make adjustments to groundwater management accordingly.

**4.5.20** ***The proponent's key prediction is that there will be prolonged drawdown along the boundary of the marsh and into a 'small' section of the marsh itself. This Department believes even this level of impact is unacceptable given the national, State and regional significance of the Fortescue Marsh. However, we also acknowledge that groundwater re-injections could potentially be used to minimise impacts on phreatophytic vegetation surrounding the marsh, if proven to be an environmentally acceptable management technique. (Submission 10)***

A vegetation monitoring and management programme will be included in the Borefield and Dewatering Management Plan. The programme will include sampling from those areas of samphire and other vegetation believed to be groundwater-dependent, and will seek to identify changes in vegetation condition that are likely to be attributable to the Cloud Break operations. This will be determined by also monitoring 'control' areas outside the influence of the Cloud Break operations. The Plan will also include potential contingency measures to avoid impacts on the Fortescue Marsh. These measures may include groundwater re-injection (the viability of which is yet to be determined), changes to mining sequences and schedules to reduce or cease dewatering in critical areas, or alternative engineering controls to reduce inflow of groundwater into the pits.

**4.5.21** ***It is critical that any monitoring programme develops management actions and 'triggers' in the event that monitoring indicates a significant decline in vegetation health, i.e. implement aquifer re-injection. There is also a need to monitor vegetation communities outside the dewatering impact area, with similar micro-environments, to account for natural variation in vegetation condition (i.e. climatic). (Submission 10)***

Refer to responses to 4.5.15 and 4.5.20.

**4.5.22** ***The use of a surface irrigation system to support phreatophytic vegetation is not supported by this Department. (Submission 10)***

FMG accepts that extended surface irrigation to maintain phreatophytic vegetation could have detrimental side effects. The comments made within the submission will be considered in the formulation of the Borefield and Dewatering Management Plan. The manner in which surface irrigation or other management measures should be implemented, if required, will be addressed in the Plan. It is likely that a hierarchical level of management actions would be applied. As discussed above other measures to avoid impacting phreatophytic vegetation may include groundwater re-injection, changes to mining sequences and schedules to reduce or cease dewatering in critical areas, or alternative engineering controls to reduce inflow of groundwater into the pits.

**4.5.23** ***It seems that the 'oldest' data on the hydrogeology of the Marsh is from September 2004. More data should be collected before this Project is further considered for environmental approvals. (Submission 8)***

There is data from prior to September 2004, however it is limited and some of it is considered unreliable. The data has been collated and used in the numerical modelling where appropriate. FMG is continuing to collect monthly data from bores drilled for the Project and a sample of station bores.

**4.5.24** ***More monitoring and modelling needs to be done to establish the natural seasonal variation in groundwater levels. This is especially important given that this section seems to suggest that groundwater will be lowered below the fringes of the Marsh (as we understand it, the samphire flats are within the boundary of the Marsh). High value environmental assets cannot be put at risk on the basis of limited data. (Submission 8)***

FMG is committed to continuing monitoring of water levels from its current network of bores and extending this network prior to licensing. The results of the data collection will be incorporated into the model on an annual basis to refine the model predictions. The current water level data suggest that, during dry periods, groundwater levels in the vicinity of the Marsh are below 5 m BGL.

**4.5.25** ***It is noted that large drawdowns are possible in the Marra Mamba, but it seems that not enough sampling has been done. Appropriate surveys must be done before the Project is further considered for environmental approvals. (Submission 8)***

Drawdown will occur in the Marra Mamba and the Tertiary deposits. FMG has developed an extensive network of bores and each of these bores has been surveyed. Water level and water quality data has been collected from each of them on a monthly basis.

Furthermore FMG has undertaken test pumping on several bores between the Cloud Break deposit and the Marsh to help determine the aquifer parameters used in the model. FMG will continue to undertake monthly surveys of water levels and water quality in the Cloud Break area throughout the life of the Project.

**4.5.26** ***The hydrogeology report presents a feasible conceptual model for the groundwater system from the Chichester Ranges to the Marsh and across the valley. This model includes the recharge/evaporation mechanisms of the Fortescue Marsh. The recharge/evaporation model is based on data collected in 2004, but there is no indication in the report of whether 2004 represents a typical rainfall and groundwater year. Other locations in the Pilbara have recorded exceptional rainfall in 2004 due to cyclones Monty and Fay, so this model needs to be regarded as conceptual, and not quantitative. Data for 2005 is being included to refine the groundwater model but has not been included with the final PER. The extra meteorological data will need to be included in the submission for the groundwater license. (Submission 9)***

The recharge evaporation model is based on data from Newman collected over a considerable time-period, not just 2004. FMG will continue to develop and refine the model as new data becomes available (both meteorological and groundwater).

**4.5.27** ***The groundwater model is based on limited hydraulic and drilling data. The model***

***should be revised as new drilling and testing information is collected, and has been refined since the version included in the PER. Significant changes to the groundwater model would be expected in the early years of mine operation based on monitoring data and revisions to hydraulic parameters. This requires careful monitoring by WIAB and licensing officers. The Project proposal does not provide a detailed groundwater-monitoring network, so this will need to be managed through groundwater licensing. (Submission 9)***

Whilst pumping tests have been undertaken, FMG accepts that dewatering of the pits provides the best data against which to calibrate the model. FMG accepts the point that changes will be made to the model during the early years of mining. FMG also states that there is least risk to the Marsh, phreatophytic vegetation or station bores during this early phase.

FMG will submit a draft monitoring plan, based on its current monitoring programme to State Government agencies for comment. Changes will be made to the plan to incorporate those comments. Once licences are in place, the operations will be the subject of annual reporting.

**4.5.28** ***The dewatering model is discussed in Appendix F to the Hydrogeology Report, and this discussion identifies additional work both before and during mining to refine the dewatering model. WIAB would need to see the results of this additional work before issuing the water extraction licenses. (Submission 9)***

FMG proposes to submit the results of this work to the WIAB prior to any licence application.

**4.5.29** ***The use of evaporation ponds close to the marsh will need to be very carefully managed. Management criteria must include prevention of runoff from cyclonic rainfall events (for example a 1:200 weekly rainfall, and a 1:1000 daily rainfall, to be negotiated before works approvals are lodged), and groundwater monitoring for a period consistent with modelled groundwater flow rates around the underground salt disposal sites. Reliability of liners for evaporation ponds needs to be addressed in the detailed design of ponds, and should be explained in the PER. The proponent should be aware that the evaporation ponds would become temporary saline wetlands in the seasonally arid Pilbara environment, so the environmental impacts need to be addressed in discussions of impacts on flora and fauna, including migratory avifauna. (Submission 9)***

As discussed in the PER, FMG is not proposing to use evaporation ponds close to the Marsh. Further work undertaken by Aquaterra has clarified that the quality of the water to be extracted during dewatering is not hypersaline. Instead FMG is proposing to use storage ponds, created during pre-stripping of several of the pits, to store water before its subsequent transport to the ore-beneficiation plant at Christmas Creek. Potential issues with avifauna are discussed briefly in 4.5.14.

**4.5.30** ***EPASU should advise FMG that if the main PER document does not discuss the evaporation ponds proposal (even if it is included in the Hydrogeology appendix), then any later plan by the company to dispose of excess water by evaporation would require further referral to the EPA for formal assessment. (Submission 9)***

Section 6.6.2 and Appendix C of the Cloud Break PER discuss FMG's preferred method for managing

water from pit dewatering. It is proposed that that there would be six storage ponds each 500 m by 1000 m. These ponds would be located on areas which will eventually be disturbed by mining. Other possible options for disposal are also considered in this section, including evaporation ponds, and aquifer re-injection which FMG has committed to further review.

**4.5.31** ***Proposals to reinject into the Marra Mamba Formation, or to dispose of excess water in finished mine pits, would both require a temporary disposal or storage of potentially-saline water, and would only be feasible after several years of mining. The EPA should encourage FMG to explore these options further. (Submission 9)***

FMG recognises that re-injection of water or disposal in finished pits would require licensing. FMG is proposing storage of the dewatered water in a series of storage ponds (refer to response 4.5.29). The modelling work undertaken for the PER report shows that it is unlikely that the water abstracted during dewatering will be hypersaline.

**4.5.32** ***The revised groundwater model presented in early August 2005 incorporates additional numerical element (MODHMS secondary model), which can analyse groundwater inflow into mine pits during and after mining, and this allows a refined model to forecast salinity changes in the pits. Based on the material presented by Aquaterra in October, FMG is confident that the proposed evaporation ponds would not be required, so FMG may delete these from the operation, although still listed as a preferred option in the PER document. WIAB remains concerned that this analysis, while more quantitative and precise than that presented in June, is based on a simplification of the natural system and uses sparse data to build the models. (Submission 9)***

The data used to construct the models is being updated during the on-going programme of monitoring. The numerical model will be re-calibrated annually to take into account increases in knowledge. The results will be made available to State Government agencies along with all the monitoring data. Additional monitoring data supports the current view that evaporation ponds will not be necessary and construction of temporary storage ponds within the mine footprint will provide a means of storing this water until it can be used by the Stage B Project.

**4.5.33** ***The revised Hydrogeology appendix incorporating the updated modelling has not been incorporated in the PER. FMG will need to provide a detailed technical briefing to WIAB hydrogeologists and modellers as supporting documentation for the groundwater license application. (Submission 9)***

The revised Hydrogeology appendix was included in the PER. It is possible that this submitter is reading a previous draft of the PER. Appendix F to the Hydrogeology Report identifies additional work both before and during mining to refine the dewatering model prior to licensing. The results of this further work will be provided to WIAB as it is completed.

In the development of the PER, detailed briefings were provided to the WIAB as improved modelling information become available. It is FMG's intention to continue this approach.

## 4.6 FLORA AND VEGETATION

**4.6.1** ***Concerns over the massive proposed footprint of the Project and the true loss of vegetation that may result from area to be cleared. It is simplistic to believe that "Total area of disturbance over LOM" will exactly match the "Total area of rehabilitation over LOM" (p. xi). (Submission 2)***

As stated in Section 6.2.1 of the PER, vegetation clearing will be kept to a minimum necessary within engineering and safety requirements. The proposed area of disturbance shown in Tables E1 and 4 therefore represents the upper limit of what could potentially be affected by the Project.

FMG propose to progressively backfill mined-out pits and rehabilitate these areas and any remaining waste rock and overburden stockpiles. On completion of mining all infrastructure will be removed and the area rehabilitated unless it is required by the lessee. The proposed area of rehabilitation shown in the PER (Tables E1 and 4) therefore also represents the maximum area that will be rehabilitated, although it is acknowledged that the total area of disturbance over the life of the Project may not exactly match the total area of rehabilitation.

**4.6.2** ***Concerns over the significant amount of clearing that is to take place and the identification that several vegetation types within the proposed mining areas have been identified as being of restricted occurrence or otherwise significant. Want a vegetation action plan to be developed to ensure that restricted occurrence or otherwise significant vegetation will not be threatened in the long term as well as rehabilitation goals (perhaps form a component of the Revegetation/Rehabilitation Plan). (Submission 2)***

As stated in Section 6.2.1 of the Cloud Break PER, during the final design of the Project there will be further refinements to take into account the locations of regionally significant vegetation types and to avoid these where practicable. Permanent vegetation monitoring plots will also be established and monitored prior to, during and after mining activities and will include monitoring of significant vegetation types. The Rehabilitation and Revegetation Management Plan (Appendix J of the Cloud Break PER) includes research and monitoring which will provide useful data for the protection of significant vegetation types.

**4.6.3** ***Information in the PER does not provide any indication of the area (ha) and percentage of each vegetation community currently in conservation estate. The PER lists significant flora and vegetation communities but provides no data of their significance in either a local or regional context. This type of information is needed to provide some context for the justification of the Project i.e. economic gains during the 12-year mine life and the environmental costs. (Submission 4)***

In assessing the significance of the vegetation in a local and regional context, it was necessary to rely initially on the regional vegetation mapping by Hopkins et al. (2001) and Beard (1975). The land system work by Payne et al. (2002) was also used. At more detailed levels, FMG relied on previous studies in the area by Mattiske Consulting, Biota (2004) and van Leeuwen and Bromilow (2002) which are restricted in their scope. Therefore, the determination of significance at a more detailed scale cannot be based on spatial information in different areas as this level of mapping does not exist for all of the Pilbara or the reserve systems. FMG did, however, identify a number of communities with significant conservation values and considered these communities in project planning. These findings

were based on the interpretation of ecologists with substantial experience in the Pilbara.

**4.6.4** ***"While the location of the mine is dictated by the location of the deposit, the associated infrastructure can generally be located to avoid areas of higher conservation value." (p.82). Management measures discussed in the PER include threatened flora rehabilitation research, weed and fire management. The Society does not believe that rehabilitation of the 5,500 ha area will be satisfactory (see below). We believe the impacts on the vegetation, Fortescue Marsh, and high likelihood of very poor rehabilitation cannot be justified. (Submission 4)***

The above work proposed on threatened flora rehabilitation research, weed management and fire management is considered by FMG to be a normal part of Environmental Management of its activities. FMG will work to ensure that direct and indirect impacts on vegetation are kept to a minimum, and believes that, with appropriate research and rehabilitation trials, disturbed areas can be successfully rehabilitated.

Rehabilitation trials will be undertaken throughout the life of the Project to investigate the likely success for revegetation using different methods, and addressing the issues of water relations, weed invasion, and changes in topography and soil structure. Investigations have been conducted into rehabilitation methods for Mulga communities in the Pilbara. This review has highlighted that with appropriate topsoil/overburden handling and seeding it is feasible to undertake Mulga rehabilitation in environments similar to the Project area (*pers. comm*. Mattiske, 2004). In the event that rehabilitation is unsuccessful in certain areas remediation works may be undertaken. This may include repair of eroded areas, weed control, and seeding or planting of areas where vegetation has not established from natural seed sources in the applied topsoil and mulch.

The rehabilitation programme will include development of rehabilitation and revegetation completion criteria in consultation with key stakeholders. These criteria will define when a rehabilitated area can be considered self-sustaining, or indicate a continuous positive trend towards a stable community. Regular monitoring will be carried out to determine rehabilitation success (refer to Appendix J of the PER).

**4.6.5** ***The PER states (p.xv) that most vegetation is expected to be unaffected by dewatering operations unless groundwater drawdown is sudden, or vegetation is already subject to other stresses (e.g. drought). How will FMG manage vegetation for conservation if things go wrong? (Submission 4)***

Detailed in Section 6.6.1 of the Cloud Break PER, FMG will develop a Vegetation Monitoring and Management Programme (as part of the Borefield and Dewatering Management Plan) which will include permanent vegetation monitoring plots to be monitored prior to, during and after borefield operations, to ensure that any impacts on potentially groundwater-dependent vegetation are adequately managed. Measures will include, but not be limited to:

- the construction of groundwater bores to monitor water levels in the alluvial and basement aquifers along creeks where vegetation might be effected, prior to commencement of abstraction;
- sampling of groundwater in the vicinity of Cloud Break to monitor changes in salinity in the alluvial aquifer during dewatering;

- development of improved numerical groundwater models and annual calibration of these models, so that future drawdowns, for the life of the Project, can be identified in a timely manner before potential impacts occur; and
- assessment of vegetation condition in groundwater drawdown areas (commencing prior to abstraction).

If groundwater monitoring and vegetation condition assessments indicate a likely decline in vegetation condition due to drawdown, dewatering operations will be modified and FMG will consider the option of irrigation systems to support selected communities outside the proposed mining areas (refer also to response 4.2.15).

The results of vegetation monitoring within the groundwater drawdown zone will be reported in the Annual Environmental Report, which is submitted to the DoE and the DoIR.

**4.6.6** ***In the event that a previously unknown population of threatened flora is identified in the disturbance area, in what instance would removal of the whole population change the conservation status of the species? Given that removal of the whole population wouldn't necessarily change the conservation status, what conditions will CALM place on the protection of species populations, e.g. will FMG consider translocation of the species? How would these conditions affect operations on Mulga Downs station? (Submission 5 – Table 1)***

The impact of disturbing a population of threatened flora on the conservation status of that species depends on its local and regional distribution. As stated in Section 6.2.8 of the Cloud Break PER, the locations of significant flora populations would be avoided if practicable in the final design of the Project. Known populations of threatened flora are shown in Figure 10.

If for some reason a population of significant flora could not be avoided (e.g. it occurred on an orebody), then this would be assessed on a case-by-case basis in consultation with CALM, and appropriate management measures (which could include translocation) would need to be implemented for approval to disturb this population to be granted. Other management measures may include research into propagation of the species for use in rehabilitation of the mining area. The pastoral lessee would be consulted if there was potential for proposed management measures to affect pastoral activities.

**4.6.7** ***The area of disturbance to Mulga communities is inconsistent between the FMG Stage B PER and the FMG Cloud Break PER within each of the management units. The impact of the FMG Projects on Mulga communities is therefore unclear. (Submission 6)***

As discussed in Appendix B of this document and the Cloud Break PER, the Stage B Project has been revised, which includes reducing the proposed area of disturbance. The assessment of the potential cumulative impacts of FMG's Projects on Mulga communities in Section 6.14.2 of the Cloud Break PER takes into account the impacts of the revised Stage B Project (refer to Table 20 of the Cloud Break PER).

**4.6.8** ***From the review of the PER document it is the opinion of the Region that the proposed clearing may be at variance to several of the vegetation principles outlined in the EP***

***Act. (Submission 7)***

See responses to 4.6.9 through to 4.6.14

**4.6.9** ***The proponent may not have classified the vegetation appropriately. Mattiske found that the vegetation was considered to be "good to degraded". The Region has come to the conclusion that the vegetation is in a 'good' to 'very good' condition. (Submission 7)***

The vegetation in the Cloud Break area has been degraded by a range of factors - drought, repeated fires and pastoral activities. The assessment by the Mattiske team was based on detailed observations and some 30 years of experience in the Pilbara Region; and whilst it is recognised that some factors are temporary, the frequency of fires and the degree of pastoral activities has led to declines in the communities within the Project area. Plates 1 and 2 show examples of fire and grazing impacts within the Cloud Break Project area.

Observations of Dr Grace Wells and Dr Grant Wells of G&G Environmental Pty Ltd during a recent (13-14 October 2005) survey for priority flora at the Cloud Break lease agree with the Mattiske recommendation that some vegetation should be described as degraded. For substantial areas in the vicinity of stock water points the natural shrub layer is severely depleted and in many areas inhabited primarily by heavily grazed plants of the introduced *Cenchrus* grasses. These areas could not be described as in good condition according to the scale applied.

On page 8 of Appendix E (Review of Vegetation Condition on the Cloud Break Lease Area, Mattiske Consulting Pty Ltd 2005) it is suggested that some areas of vegetation may become classified as in very good condition should future impacts be minimised.

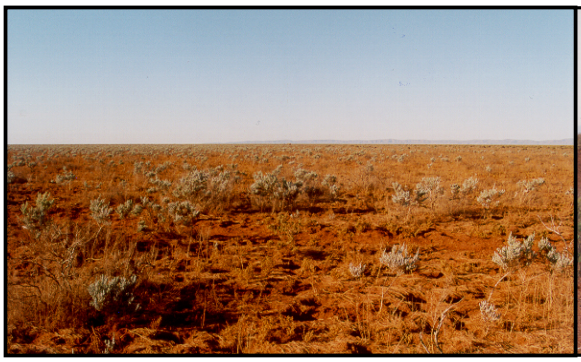

Plate 1: Impacts from grazing at Cloud Break

Plate 1: Impacts from fire at Cloud Break

**4.6.10** ***Four vegetation communities are considered regionally significant as they are locally restricted and associated with the Nationally Significant Fortescue Marsh. Long term impacts to these communities (the four regionally significant) vegetation communities by changes to the water regime are not specified in the PER. The flow on effects of this disturbance to the samphire flats to the Fortescue Marsh must also be considered. The impact of the proposed mining activity on these communities outside the areas to be cleared must also be considered. (Submission 7)***

FMG commissioned Barrett and Associates (2005) to undertake an evaluation of the likely impact of drawdown on vegetation communities (Appendix F of the PER). As noted by Barrett, the hydrological model suggests a maximum fall of 0.5 – 1.0 m in groundwater at the fringes of the samphire communities and up to 5 m in an area at the north-west extremity of the operation. While the potential for some adverse impacts from a temporary groundwater drawdown cannot be ruled out, in most areas the drawdown appears to be within the fluctuations that are likely to occur within the natural cycles of flooding and aridity. Samphires are likely to survive naturally occurring falls in groundwater through changes in root architecture and through utilisation of soil moisture derived from flood events. In the event that reductions in groundwater levels are prolonged during extended arid periods, samphires are equipped with various physiological mechanisms to survive.

FMG has committed to ensuring that there are no indirect and direct impacts on the Fortescue Marsh as a result of the proposal. Additionally, FMG has committed to a number of monitoring measures (including vegetation monitoring) which will enable FMG to determine changes in vegetation over time. Management measures could then be implemented prior to the onset of any potential impacts.

**4.6.11** ***While there are no conservation areas adjacent to the proposed mine area this Project area lies within a '2015 reserve' which are areas of pastoral leases that CALM plan to acquire in 2015. (Submission 7)***

FMG's Stage B and Cloud Break Projects overlap approximately 1.6% of the proposed 2015 CALM reserve. FMG is also aware of the importance of returning this land to conservation reserve, however FMG believes that its projects can proceed without significantly affecting the ecological values of the area. As part of Stage B and Cloud Break offsets (see Section 3) FMG intend to contribute to the management of the 2015 proposed reserve which in some instances would improve the existing environment. There is also a much needed research component to FMG's offsets, which will assist in understanding the complex processes associated with the Marsh. FMG believes that as a result of the offsets presented in Section 3, the environmental management practices that will be implemented, and the relatively small direct impact of the Cloud Break Project, the overall ecological values of the CALM's proposed 2015 estate would be maintained.

**4.6.12** ***An assessment of the Ecological Water Requirements (EWR) of the groundwater dependent ecosystems (samphire flats and communities containing phreatophytic species) should be undertaken. (Submission 7)***

FMG has committed to the preparation of a management plan for the Fortescue Marsh as part of the Stage B environmental assessment. This plan provides for ongoing monitoring and assessment of the condition of the Fortescue Marsh during the life of the operation. FMG will use the data obtained through these studies to assess the water requirements of samphire vegetation and other communities containing phreatophytic vegetation.

**4.6.13** ***While these species and communities may be able to recover from lowered groundwater levels in the short term, there needs to be investigation into the impact of this drawdown over a long period of time (up to 20 years). (Submission 7)***

FMG believes that the information supplied in the PER document is sufficient to enable management plans for sensitive receptors to be prepared. However, FMG understands that as the development progresses the potential for outcomes to vary from that predicted exists, regardless of the level of study carried out. Consequently, FMG has committed to carrying out ongoing monitoring of the surrounding Marsh over the length of the Project and beyond closure. FMG intends to prepare a Fortescue Marsh Management Plan in consultation with CALM in order to:

- establishing the baseline health condition of the adjacent Fortescue Marsh prior to construction undertaken as par to the proposal;
- monitoring and assessing any changes in the health of the adjacent Fortescue Marsh attributable to the Project; and
- implementing appropriate actions, where necessary, to maintain the health of the adjacent Fortescue Marsh.

**4.6.14** ***The PER states that the risks to phreatophytic vegetation from groundwater drawdown were considered to be manageable, however the management strategies to avert these risks are not detailed in the PER. (Submission 7)***

Refer to response 4.5.15.

**4.6.15** ***Land clearing: the amount of clearing associated with the proposed new mines is very significant. We note that up to 5,000ha will be lost no doubt this vastly underestimates matters after hydrological impacts have been taken into consideration. The cumulative direct clearing noted here, at almost 18,000 hectares, is highly disturbing. We note that this estimate has not been independently verified and that the areas have not been the subject of multi-year, detailed, and independent surveys. (Submission 8)***

FMG will make every effort to limit clearing to that absolutely necessary for the Project. Furthermore, FMG will be required to survey and report on areas cleared, and progress towards rehabilitation, in annual reports to the DoIR and DoE. There is no evidence in the environmental impact assessment to suggest that there will be additional vegetation losses from “hydrological impacts”.

With regard to “multi-year, detailed and independent surveys”, FMG has conducted detailed investigations into the likely environmental impacts of the Project including vegetation and fauna surveys as detailed in Appendix F and G of the Cloud Break PER. The scope of the studies conducted were outlined in the Project’s scoping document and have been undertaken in a manner consistent with guidelines issued under the *Environmental Protection Act (1986)*, in particular Environmental Protection Authority (2002).

**4.6.16** ***It is widely recognized that at least 15% of the pre-European extent of each native vegetation association should be reserved in the conservation estate in order to ensure the long-term viability of that association. Less than 1% of the Fortescue IBRA sub-region is so reserved, and less than 4% of the Chichester sub-region. (Submission 8)***

Cloud Break will disturb approximately 0.3% of the current existing Fortescue IBRA sub-region and none of the Chichester sub-region. This proposal will not limit the ability to reserve 15% or more of any vegetative association affected by the Project.

Further, it is FMG's intention to progressively rehabilitate all areas disturbed during mining. In addition, aspects of the offset packages outlined in Section 3 will result in a net improvement of the ecological values of most vegetation associations impacted by this Project, particularly through fencing to exclude grazing cattle and the implementation of a weed extension programme.

**4.6.17** ***Are any of the vegetation communities recognised as TECs by the State Environment Minister? The EPBC list is hardly exhaustive and English and Blyth (1997) is not current. (Submission 8)***

The Project area does not contain any Threatened Ecological Communities (TECs) pursuant to Schedule 2 of the *EPBC Act (1999)*, or identified as Threatened in English and Blyth (1997). Communities are described as TECs if they have been defined by the Western Australian Threatened Ecological Communities Scientific Advisory Committee and found to be Presumed Totally Destroyed (PD), Critically Endangered (CR), Endangered (EN) or Vulnerable (VU). Selected plant communities have also been listed as "Threatened Ecological Communities" under the *EPBC Act (1999)*. The status of TECs for the Project area was determined by doing a search of the relevant databases including the CALM and DEH websites.

## 4.7 WEED MANAGEMENT

**4.7.1** ***The development of a Weed Hygiene and Management Plan for the Cloud Break site is supported by this Department. The Plan should be considered a high priority and needs to be reviewed by this Department and implemented as soon as possible. (Submission 10)***

The Weed Management Plan is the same Plan to be used at the Stage B operations. The current version of this Plan has been reviewed by CALM. However, as part of the proposed offsets, the Plan will be extended in consultation with CALM to focus not only on the introduction and spread of weeds, but reducing (and if possible eradicating) weed infestations, not only within the Project area but also in adjacent areas selected collaboratively with CALM and Department of Agriculture.

## 4.8 TERRESTRIAL FAUNA

**4.8.1** ***The fauna report does not address basic issues required in Position Statement No. 3. (Submission 1)***

FMG and its consultants consider that the fauna report does address the basic requirements of Position Statement No. 3. This work was also considered in the light of previous work undertaken in the area and discussions with CALM and the DoE about the Project. This issue has been addressed previously in the response to submissions for Stage B.

**4.8.2** ***The survey effort is insufficient to adequately assess the terrestrial fauna assemblages in each of the habitats. There is a mosaic of vegetation across the site which indicates a number of fauna habitats, each of which should have be been adequately surveyed to describe at least 80% of the small vertebrate species and their relative abundance. This has not been done. (Submission 1)***

Sampling sites were selected to encompass both a geographical spread and a diversity of habitats and landforms. Over such a large survey area it is not possible to sample every different vegetation type and landform. However, a range of these habitats within the Cloud Break Project area were sampled.

It is not clear where the 80% figure comes from. Because of previous work in the area and records from databases, it was possible to prepare a vertebrate species list for the area with a high degree of confidence. The predicted species lists are likely to be more than 95% accurate, with errors of inclusion rather than exclusion.

Sampling served to confirm the presence of some of these species. Relative abundance of all but the most common species (perhaps of 25% of the faunal assemblage) cannot be determined without a massive survey effort over many years, and it is doubtful that such information would be especially useful. In semi-arid and arid regions, abundances vary greatly from year to year, so environmental impact assessment needs to be more about impacts on processes and proportional habitat loss rather than species lists.

**4.8.3** ***There has been almost no assessment of the available literature on fauna assemblages for the bioregion, thus the data are not considered in a regional context. (Submission 1)***

The WA Museum's Faunabase, CALM's Threatened and Priority Fauna Database, the Birds Australia Atlas Database, the EPBC Protected Matters Search tool and previous surveys conducted by Biota Environmental Sciences in the area, were used in the fauna assessment for the Project.

The fauna recorded as a result of surveys and studies for the Cloud Break Project, was mostly typical of fauna recorded in other studies in the Pilbara region. However, results from CALM's Pilbara surveys are not yet available. It is acknowledged that the results of other fauna surveys conducted for the mineral industry could, at least in some cases, have been accessed, although this would have been laborious and time-consuming, and is not considered to have added significant value to the assessment.

**4.8.4** ***The methods section acknowledges the need for a 2 season survey yet the proponent has only undertaken a single survey during the wrong time of the year. (Submission 1)***

Western Wildlife and Bamford Consulting Ecologists conducted two survey campaigns, one between the 7 - 17 April 2005 and one between the 18 – 29 May 2005 (see page 31 of the Cloud Break PER). It is acknowledged that the May 2005 survey was primarily a follow-up survey for the Night Parrot, however, observations and sightings from this survey were included in the fauna report (such as the Bilby colony). In June/July 2004, Biota (2005) also under took a substantial survey effort for the Stage B railway corridor which traverses the Cloud Break Project Area. It would be unlikely that additional survey efforts would substantially change the outcomes of the work for the purposes of the *Environmental Protection Act 1986* impact assessment process.

It should also be noted that the sighting of the Night Parrot changed the focus of the fauna studies from a general survey to a survey targeting a species of very high conservation significance. Furthermore, the approach taken with the follow-up survey that targeted the Night Parrot resulted in the discovery of Bilbies in the area. The Bilbies would probably not have been discovered with a conventional general survey, as such surveys tend to focus on small areas for the purposes of trapping. The Night Parrot survey involved personnel covering large areas of habitat on foot and it was by this means that the Bilbies were located.

**4.8.5** ***April is much too late to maximise catch rates (see How, R.A. and Dell, J. 2004 Reptile assemblage of the Abydos Plain, north-eastern Pilbara, Western Australia. Journal of the Royal Society of Western Australia 87: 85-95), the lateness of the survey is reflected in the low number of individuals caught. (Submission 1)***

It is well accepted that a single seasonal survey will not adequately document the entire vertebrate assemblage of any given area. This takes years, especially in the Pilbara where species vary in abundance with annual conditions. The report did draw on the earlier sampling carried out in June/July 2004 by Biota (2005) in the same general area.

The Cloud Break fauna survey was timed to occur after the season of maximum rainfall. This is consistent with EPA Guidance No. 56, which states that "a survey in that follows the season of maximum rainfall is generally the most productive and important survey time". In the Pilbara the wettest periods are generally associated cyclonic conditions between December and March, hence the April survey.

**4.8.6** ***The impact of the loss of vegetation on fauna communities has not been the subject of multi-year, independent studies. (Submission 8)***

Refer to response 4.8.5.

The scope of the studies conducted were outlined in the Project's scoping document and have been undertaken in a manner consistent with guidelines issued under the *Environmental Protection Act (1986)*, in particular Environmental Protection Authority (2002).

**4.8.7** ***Surveys for Bats were only limited to two nights which is hardly adequate when there is the possibility of species of conservation significance in the area. (Submission 1)***

As outlined in the Cloud Break fauna report, bat surveys were conducted through the use of three mist nets, an Anabat II ultrasonic detector and by searching for roosting sites. It is acknowledged that mist nets were only used for two nights on the 11$^{th}$ and 14$^{th}$ April 2005. However this was supplemented by other survey methods mentioned above, which were carried out over the entire

survey period. Searching for roosts was also carried out during the May survey. Biota (2005) sampled over 30 locations for bats.

The possibility of bat species of significance in the area remains although they were not located. However, the habitat and particularly roosting requirements of these species are known and while such areas were targeted during surveys, these will not be impacted by the Project. Opportunistic searching of potential sites will take place in the future.

### 4.8.8 *Surveys for invertebrates were not done and SRE (short range endemics) invertebrates should have been addressed. (Submission 1)*

***From discussions during the site visit undertaken by our Cameron Poustie, it seemed that there has been no sampling of burrowing frogs, and no work relating to terrestrial invertebrates. These gaps should be addressed before the Project should be further considered for environmental approval. (Submission 8)***

It is acknowledged that the surveys for invertebrates were not done in this particular survey. However, they were carried out by Biota (2005) for the Stage B rail corridor, which traverses the Cloud Break Project Area.

Biota (2005) targeted invertebrate groups and these were sampled through opportunistic and systematic collections. Prior to field work, WA Museum staff were consulted to confirm invertebrate groups of interest and to identify any specific curation methods (e.g. the preservation of Wolf Spiders for DNA analyses). Invertebrate groups targeted during the Biota (2005) survey included:

- Araneae (spiders, in particular trapdoor and wolf spiders);
- Pseudoscorpionida (pseudoscorpions);
- Scorpionida (scorpions);
- Diplopoda (millipedes); and
- Pulmonata (land snails).

One of the fundamental problems with assessing the likely occurrence/distribution of Short Range Endemics in the Pilbara is the paucity of targeted collecting. This is compounded by a lack of taxonomic work on most taxa collected. As such, FMG's consultants were not in a position to identify to species level the majority of invertebrate fauna collected during the FMG Stage B survey. Of those specimens collected that could be identified, two mygalomorph spiders are potential Short Range Endemic taxa:

- *Aganippe*? sp. (Idiopidae) from site FMG08 in the Mindy Mindy study area (WAM T62547); and
- *Synothele* sp. (Barychelidae) from site FMC01 in the Christmas Creek study area (WAM T62548).

FMG will also undertake further fauna surveys prior to ground disturbing activities and this work would include further work on invertebrates.

**4.8.9** ***Twenty species of Scheduled or Priority listed fauna were recorded or have the potential to occur within the Cloud Break area. Further to this, the Fortescue Marsh episodically support immense water-bird breeding. It is one of only two inland breeding colonies of pelicans in WA. (Submission 7)***

It is acknowledged that the area is rich in species diversity. However these species have co-existed for many years with other human activities such as intensive pastoral activities. Native fauna are also generally transient and not necessarily restricted to specific locations (pers comm., Mike Bamford 2005).

As stated in the PER, FMG has identified that noise and vibration may impact on water birds utilising the marsh. However, the Department of Environment and Heritage notes that research into the effects of noise on animals are relatively scarce (Environment Australia, 1998). Most studies of noise impacts on birds to date have been undertaken in Europe or America, with particular reference to military operations. Although many of the studies were inconclusive, it is known that a large number of animals have adapted to the presence of humans and the noise generated from humans. The animals initial reaction to a new noise source may be fright and avoidance, but if other sensory systems are not stimulated (sight and smell), the animal learns quite quickly to ignore the noise source.

FMG is proposing the use of surface miners, which if proven successful in FMG's ore body, would result in the minimal use of blasting and hence a reduction in potential noise impacts. Additionally FMG will also ensure that low flying aircraft do not fly over the marsh (particularly during breeding season). FMG has committed to the development of a Noise and Vibration Management Plan and to monitor the effects of blasting on birds. It should be noted that the marsh is 3 km from the closest pit, and many of the proposed mining areas are significantly further away than this. Noise levels would also reduce as the pits become deeper.

**4.8.10** ***No survey work has been undertaken on invertebrates that inhabit the marsh ecosystem, and their dependence on natural seasonal fluctuations in surface water hydrology. (Submission 10)***

Fauna surveys to date have focused on areas proposed to be impacted on by the Project. No survey work has been undertaken on invertebrates that inhabit the marsh ecosystem, as this is considered outside the scope of surveys required for environmental impact assessment. FMG has recognised little is known about invertebrates (especially Short Range Endemics [SRE]) and has proposed to undertake research to further understand SRE invertebrates as part of its offsets (refer to Section 3 of this report).

**4.8.11** ***This Department is aware that detailed fauna surveys were undertaken in April and May 2005 for vertebrate fauna (p. 31). However, there has been no discussion or survey work (desktop or on-site) undertaken for invertebrate fauna in the Project area, including short range endemic fauna or aquatic invertebrates. The marsh and fringing mulga are potentially important habitat for invertebrates. In particular, the degree to which aquatic invertebrates are dependent on the hydrological regimes of the Fortescue Marsh is largely unknown. (Submission 10)***

It is acknowledged that the surveys for invertebrates were not done in this particular survey. However, they were carried out by Biota (2005) for the Stage B rail corridor, which traverses the

Cloud Break Project Area (refer to response 4.8.8). FMG has recognised little is known about invertebrates (especially SRE) inhabiting the Project area and will undertake research to further understand SRE invertebrates. FMG will also undertake further fauna surveys prior to ground disturbing activities and this work would include some work on invertebrates and SRE.

**4.8.12** ***There are too few trap nights to record species richness, fauna assemblage and structure, all rare and protected species, record range restricted species and to describe ecosystem values. (Submission 1)***

***Insufficient trapping effort and inappropriate survey period meant insufficient data are provided to address biodiversity conservation and ecological function values. (Submission 1)***

Fauna surveys and trapping will never record all fauna species that may occur within a study area and this is a well recognised limitation. Consideration must be given to other components of the survey and should not just focus purely on trap efforts. The Fauna report outlines a range of supplementary methods used to detect terrestrial vertebrate species in the Project area including;

- spotlighting;
- searching specific microhabitats by hand;
- opportunistic sightings and records; and
- identification and recording of secondary signs including tracks, scats and diggings.

These methods supplement surveys for impact assessment when Project and logistical constraints dictate that a 5 year seasonal study cannot be undertaken. The data from the Cloud Break survey indicates that the number of taxa recorded (141 vertebrate taxa) is typical for a survey of this length and in this bioregion. However, it must be noted that the trapping effort for the Cloud Break Project Area can also be supplemented by data gathered by Biota (2005) who recorded 178 vertebrate taxa during surveys conducted in the same area for Stage B. As discussed in response 4.8.5 the Cloud Break survey was in fact conducted in a month which would be considered “appropriate” for the region.

It is well recognised that even after 10,000 trap nights, species lists are rarely complete due to the rarity of some of the species and the fact that others are never or almost never caught in traps. It is not clear how many trap nights would be required to achieve this in the Pilbara and there is likely to be no ‘true value’, as the number of animals trapped will depend on climatic and meteorological conditions as well as stochastic effects. It is considered impossible to predict how many trap nights would be required to get a ‘full’ species list.

**4.8.13** ***There are no species accumulation curves; total captures of between 3 and 18 small vertebrates per habitat type clearly indicate an inadequate trapping effort. There is no possibility that these data in any way represent the faunal assemblages at these sites. (Submission 1)***

Species accumulation curves are a useful measure of sampling adequacy, but they are only one measure of the adequacy of a fauna survey. There are many other non-systematic sampling methods available that do not lend themselves to such an evaluation, but significantly affect the adequacy of surveys in documenting the fauna of a given survey area.

It is acknowledged that there are species present in the corridor which were not captured in traps, which is why non-systematic means were employed to supplement the trapping component. As noted in response 4.8.12, the number of taxa recorded during the survey was comparable to other recent Pilbara surveys of a similar scale.

**4.8.14** ***There is almost no ecological analysis of the scarce amount of data presented. Lists and descriptions provided in Appendix 2 are of little or no value in addressing the primary purpose of the EPA. The consultant could have used the time more productively describing biodiversity conservation and ecological function values for each biotope and placing the data into a regional context. (Submission 1)***

Annotated lists provide a summary of the habitat preferences of each species within the study area and also provide other fauna specialists reading the document with useful insights into records of any given species. It is considered that annotated lists are an important part of the fauna report. The format has been followed for benchmark regional studies completed by both the WA Museum and CALM.

**4.8.15** ***Although the report refers to reports by Biota, these data have not been used in any meaningful way in the fauna report. The Pilbara Biological Survey database (http://science.calm.wa.gov.au/pilbaradb/) reports a large number of biological surveys for the Pilbara, but this has not been accessed to put the data into context. (Submission 1)***

The results of the Cloud Break fauna survey have been discussed in the context of Biota's previous findings throughout the fauna report. The website quoted does not appear to report on the large number of biological surveys for the Pilbara. Biota was instrumental in designing and populating the website referred to and it is a meta-database – no actual data from the Pilbara surveys is available on the CALM website.

**4.8.16** ***It is inappropriate to develop another classification system for species of conservation interest (e.g. CS1, CS2 and CS3). The proponent should use the established classification system as it avoids confusion and better informs the public. (Submission 1)***

The CS1, CS2 and CS3 system is a powerful tool that simplifies the established classification system, especially as the WA *Environmental Protection Act 1986* and the Federal *EPBC Act 1999* actually use different systems. The CS system recognises species with legal conservation status (CS1), which is important for proponents. The CS system also recognises species that may be of special importance for biodiversity but that have no legal or otherwise recognised conservation status. Table 2 shows the levels of conservation significance in comparison with the "established classification system".

**Table 2: Comparison of levels of conservation significance for native fauna.**

| Conservation Significance | Explanation of Conservation Significance | Established Classification System |
|---|---|---|
| | Species listed under | *EPBC Act 1999* |

| | | |
|---|---|---|
| CS1 | State or Commonwealth Acts | *EPBC Act 1999* |
| | | **Extinct**: Not located in the wild in the last 50 years<br>**Extinct in the wild:** Taxa only known to survive in captivity<br>**Critically Endangered:** Facing an extremely high risk of extinction in the wild in the immediate future<br>**Vulnerable:** Taxa facing extinction in the medium future<br>**Near threatened:** At risk of becoming vulnerable in the wild.<br>**Conservation Dependant:** Depends on going conservation measures. Without those measures would be vulnerable.<br>**Insufficiently Known***:* Suspected of being rare, vulnerable or endangered, but whose true status cannot be determined without more information. |
| | | *WA Wildlife Protection Act 1950* |
| | | **Schedule 1:** Rare and likely to become extinct<br>**Schedule 2**: Extinct<br>**Schedule 3:** Migratory Birds listed under international treaties<br>**Schedule 4:** Other protected fauna |
| CS2 | Species not listed under State or Commonwealth Acts, but listed in publications on Threatened Fauna or as Priority species by CALM. | **Priority 1**: Taxa with few, poorly known populations on threatened lands<br>**Priority 2:** Taxa with few, poorly known populations on Conservation lands or taxa with several, poorly known populations not on conservation lands<br>**Priority3:** Taxa with several poorly known populations, some on conservation lands.<br>**Priority 4:** Taxa in need of monitoring. Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be present if circumstances change.<br>**Priority 5**: Taxa which are not considered threatened but are subject to a specific conservation programme, the cessation of which would result in the species becoming threatened within five years. |
| CS3 | Species not listed in Acts or in publications | Not applicable |

**4.8.17** ***The survey effort is not adequate to be sure what species of conservation significance are in the area. A fortuitous sighting of the Night Parrot has resulted in less attention being given to other species like Mulgara and Bilbies, which should have been adequately surveyed. The suggested additional surveys should be carried out and the results included into the PER. (Submission 1)***

***The surveys should have been more comprehensive for Mulgara and Bilbies. (Submission 1)***

Mulgara have not been recorded within the Project area despite several surveys in the region (by Biota and Bamford Consulting) and habitats appear generally unsuitable. Bilbies were located only as a result of extra effort being put into searching for Night Parrots. The fortuitous sighting of the Night Parrot resulted in identification of bilby burrows followed by extra survey effort for bilby populations. Further work on bilbies will be undertaken.

With respect to survey effort and other significant species, it needs to be recognised that not recording a species (whatever survey effort is undertaken), does not mean the species is absent or

might not recolonise an area. The precautionary approach is to assume that significant species expected to be present on the basis of distribution and habitats are present, even if they are not found. Fauna management plans and impact mitigation need to be based on this assumption.

**4.8.18** ***Where impacts are unavoidable, documentation on why impacts will not result in unacceptable fauna loss has only had limited discussion. (Submission 1)***

The environmental impact assessment process sought to identify where impacts on fauna, amongst other things, were likely to occur. Following field surveys and review of existing data, a good understanding of the fauna in the Project area has been compiled. Based on this understanding, mitigation measures will be included in the operation's environmental management programme to minimise these impacts (see Sections 6.3 and 6.4 of the PER). These measures include specific management plans for the Bilby and the Night Parrot which have been recorded near, but not in, the Project area. On balance, the available information suggests that impacts on native fauna can be managed. In the event that new information about potential impacts on critical species comes to light, either through further survey work or other means, FMG will consult with CALM on suitable management options.

**4.8.19** ***Vouchered specimens are not provided although the report indicates that individuals were vouchered. (Submission 1)***

At the time the report was produced the WA Museum had not identified the specimens lodged. This information is now available and is listed below:

- M56292 Rock Rat *Zyzomys argurus;*
- R156460 Netted Dragon *Ctenophorus reticulatus*;
- R134067 *Morethia ruficauda exquisita* Fire-tailed Skink;
- R156461 *Ctenophorus c. caudicinctus* Ring-tailed Dragon (also second specimen that was not catalogued);
- R156462 *Ramphotyphlops ammodytes* Blind Snake; and
- *Varanus tristis* (tree goanna) that was not catalogued.

**4.8.20** ***The report was not peer reviewed. (Submission 1)***

EPA Guideline 56 states that peer review may be warranted for some EIA surveys where the EPA or the practitioner conducting the survey considers that the survey is in an area or bioregion which is poorly known or in which a limited range of specialists may be qualified or experienced.

Peer review of the Cloud Break fauna survey has not been requested by the EPA and the practitioner did not consider it necessary. In addition to published surveys conducted on the Abydos-Woodstock Reserve (How, et al. 1991; Records of the WA Museum Suppl. No. 37) and work on Birds of the Pilbara Region (Storr 1984; WA Museum Suppl. No. 16), a number of other fauna surveys have been conducted in recent years in this area by Biota Environmental Sciences for Hope Downs Management Services and FMG's other projects.

**4.8.21** ***It is recognised that the habitat requirements of many fauna species are not very well understood and caution is needed when proposing such large scale land clearing There is a need to ensure that actual and potential losses be studied, particularly in***

***terms of impacts on Federally listed threatened fauna. There needs to be comprehensive consultation with not just CALM, but also Natural Resource Management Authorities (Rangelands NRM Group) and relevant tertiary institutions so that priority areas can be avoided and mutually agreed offsets determined and the necessary research conducted so that there are lessened unknowns when considering future proposals. (Submission 2)***

FMG will implement threatened species management plans (refer to the Bilby and the Night Parrot Management Plans presented as Appendices to the Cloud Break PER) which include a monitoring component to investigate potential and actual losses of fauna and increase the knowledge of the fauna in the area including habitat requirements.

In planning its offset programme (refer to Section 3 of this Response to Submissions) FMG will consult with a range of academic advisors, expert consultants, CALM and other relevant regulatory agencies (such as NRM authorities) to identify gaps in the current knowledge.

**4.8.22** ***Need to ensure that studies take place to ensure that embankments are constructed so that they do not act as additional barriers to faunal movement and surface water movement. (Submission 2)***

During the detailed design phase of the Project faunal and surface water movement will be key items that will be considered. This will be particularly important in the design of culverts and drainage embankments which will be inspected on a regular basis, especially after rainfall to ensure they are maintained.

**4.8.23** ***The lessee of Mulga Downs station has not been consulted in regard to an animal pest management programme. The Table in the Night Parrot Management Plan (Appendix L of the PER) should be revised to state that we will be consulted as well during the implementation of a feral cat management programme. (Submission 5)***

FMG has committed to consultation with "relevant stakeholders" (which includes Mulga Downs station), in regards to a cattle management programme in the Night Parrot Management Plan.

FMG recognises that all station owners have an interest in any activities that may be undertaken on, or near, their properties. FMG has committed in Section 7.1 of the Cloud Break PER to developing a stakeholder consultation programme that will enable a free and open transfer of information to stakeholders. FMG will present the Feral Cat Management Programme developed in consultation with CALM, to all station owners prior to implementation. FMG will take into account any concerns raised by station owners at this time.

**4.8.24** ***This Department requests that the proponent provide more detail on its commitment to "discourage and control, where appropriate (in conjunction with adjacent land holders and the Department of Agriculture), feral fauna, particular cats and foxes" (p. 86). Discussion should include resource commitments, proposed area of management and proposed controlling techniques. (Submission 10)***

Since the release of the PER FMG has proposed an offsets package for the Project which includes contribution to a CALM Predator Control Programme. The detail of the programme will be determined in consultation between FMG and CALM. FMG would still carry out small scale programmes (around mine camps etc), as part of standard operating practices. The responsibility for the management of the predator control programme will be undertaken by CALM as part of its current Pilbara regional predator control programmes (refer to Section 3 for more information regarding offsets).

**4.8.25** ***It is submitted that this Project should not go ahead until such time as the Marsh can be subject to a full fauna survey while in flood. At very least, if the Project is to be approved before that time, it should be on the basis that such work will be done at that time. (Submission 8)***

Biota (2005) carried out fauna surveys in June/July 2004 in the Cloud Break Project area whilst the marsh was in flood, during the surveys for the Stage B Rail corridor. Due to the variable nature of flood cycles, it is not always practical to plan surveys to coincide with the marsh flood cycles. Overall for the Cloud Break Project, three surveys have been carried out which is considered adequate for the intent of the environmental impact assessment process, which has indicated that impacts on the Fortescue Marsh from the Project area expected to be negligible.

**4.8.26** ***It is questionable whether the impacts on waterbird, invertebrate and stygofauna values will be adequately managed given the general lack of investigations and understanding of these values. (Submission 10)***

Given that the Project Area is approximately 3 km from the Fortescue Marsh at its nearest point, the potential for impacts on waterbirds and aquatic invertebrates is limited. However, FMG acknowledges the value of the Marsh and has identified some potential impacts arising from management of surface water, blast noise and other issues, and will put in place measures to manage these impacts. A risk assessment was conducted (see Section 6.14.4 of the PER) which found the risks to be manageable. Consequently, waterbird and aquatic invertebrate fauna values are unlikely to be compromised.

With regard to stygofauna, sampling conducted to date has not identified any taxon that is likely to be significantly impacted by mining operations. FMG acknowledges however, that further work can be done and has prepared an ongoing sampling programme, as shown in Appendix K of the PER. The results of this sampling programme will be made available to CALM.

**4.8.27** ***Experience from other resource developments in the Pilbara has shown that some fauna are attracted to artificial light sources, including birds and bats. The 'Light Management Plan' committed to in the 'Night Parrot Management Plan' needs to address the impact of artificial light on fauna throughout the Project area and include commitments to mitigate these impacts. (Submission 10)***

The Light Overspill Procedure (as part of the Fauna Management Plan) will compliment commitments already proposed in the Stage B PER. FMG will manage the potential for light overspill by measures such as limited lighting directed inwardly at operations, light shielding, and selection of lights that minimise overspill and fauna attraction.

**4.8.28** ***This Department is not aware of any discussion regarding the storage ponds in relation to their ability to attract and accidentally trap fauna, i.e. similar to pipeline trenches (p. 101). The proponent needs to discuss the risks associated with the storage ponds and potential management strategies. (Submission 10)***

While lessons could be learnt from the experience with pipeline trenches in the Pilbara, the pipeline comparison is not considered entirely appropriate. Management measures common to storage ponds throughout the mining industry would be deployed. To prevent fauna from accidentally being trapped or drowned, FMG would undertake the following measures;

- fencing of the ponds;
- installation of scramble mats;
- inspections would be undertaken on at least a daily basis; and
- scaring devices could also be deployed if necessary.

FMG acknowledges that further work needs to be done on disposal mechanisms for dewatering. This is planned prior to licensing as outlined in Appendix C of the PER.

## 4.9 NIGHT PARROT

**4.9.1** ***FMG should commit to ongoing surveys for the Night Parrot within and outside the Project area in order to gain a better understanding of this species. (Submission 10)***

Annual surveys are planned throughout the Project life, as mentioned in Section 3 of the Night Parrot Management Plan. These surveys will not be limited to the Project areas.

**4.9.2** ***The most significant threats likely to affect the survival of the Night Parrot and Bilby in the Project area are introduced predators, fire, and disturbance associated with the mine operations (including habitat clearance, increases in vehicle, machinery and personnel activity, noise and light emissions). These factors must be accounted for in the management plan and appropriate measures developed to avoid and/or mitigate impacts. The current proposed plans need considerable work in this regard and in particular to identify actual management actions and timetables. (Submission 10)***

Both the Bilby and the Night Parrot Management Plans included as Appendices to the PER were early drafts, and whilst these were reviewed by individuals in CALM it is recognised that further work is required. FMG intends to amend these documents to include consideration of impacts such as introduced predators, fire and vegetation disturbance in consultation with CALM.

**4.9.3** ***We are concerned about FMG's impact assessment and proposed management of the critically endangered Night Parrot at Cloud Break. Despite being recorded on Mulga Downs station by FMG in April 2005, we were not made aware of it until we read about it in the Cloud Break PER in September 2005. (Submission 5)***

On discovery of the night parrot, FMG reported the sighting to CALM as the responsible regulatory body. CALM raised concerns over the effect that releasing this information could have, and requested that FMG refrain from announcing the sighting until the issue could be investigated and a risk assessment made. FMG complied with this request.

**4.9.4** ***We have concerns about the degree to which the proposed management measures described in the Night Parrot Management Plan could affect the day to day operations of the Mulga Downs Station (changes to cattle management, access and fire management). (Submission 5)***

FMG has committed in the Night Parrot Management Plan to consult with Mulga Downs on any issues relevant to the Night Parrot that may affect Mulga Downs' ability to operate. It is likely that the management actions for the Night Parrot will have some effect on Mulga Downs, as well as, have some effect on FMG. These management actions are necessary to protect the critical endangered Night Parrot and should be implemented regardless of FMG's presence or activities.

**4.9.5** ***FMG's Night Parrot Management Plan provides a figure showing habitat of the Night Parrot in the proposed disturbance areas for the Cloud Break Project. Surely these habitat areas are 'of conservation significance'. Is this figure incorrect? Or does FMG propose to adjust its mining plans in these areas to avoid the habitat? If this figure is correct, then does this statement remain true: …'cumulative impacts of FMG's Projects on significant fauna are expected to be minor or non-existent" (Submission 5 – Table 1)***

The preferred habitat of the Night Parrot is poorly known, with some evidence to suggest they favour the ecotone of spinifex and samphire. This ecotone is outside direct impact areas. However, there are records of Night Parrots in other habitats, so in the habitat figure FMG took the precautionary approach of encompassing all habitat that might support Night Parrots. Such habitats are extensive in the general area, but it might be possible to quantify the impact on habitats by calculating the proportion of each habitat likely to be impacted by mining. Impacts are expected to be minor because the key habitat (spinifex/samphire ecotone) will not be affected and other potential habitats are very extensive in the region. Despite this, FMG is aware of the high conservation significance of the Night Parrot and the need to understand more of its biology and particularly patterns of habitat usage.

**4.9.6** ***It is unclear in the Night Parrot Management Plan whether Biota Environmental Sciences recorded the species in the same location as Bamford Consulting Ecologists. If the species was not recorded in the exact same location, then in what area did Biota Environmental Sciences record the species? Will the Biota unpublished report be made available? Presumably CALM was provided with a copy for inclusion of the Night Parrot records in the CALM database? (Table 2) (Submission 5)***

The unconfirmed sightings by Biota Environmental Sciences were not made during work for FMG. The reference citation is to a 2005 report by Biota for FMG is therefore incorrect and resulted from a

misunderstanding in a phone conversation with Biota. The Biota sightings were made on Marillana and White Springs Stations, south of the Fortescue Marsh. CALM is aware of the Biota sightings but it is not known if they have been included in the CALM database.

**4.9.7** ***The conservation status for the Night Parrot reported in the PER is incorrect. The Night Parrot is listed under the Western Australian Wildlife Conservation Act 1950 Schedule 1, being fauna that is rare or likely to become extinct as specified in the Wildlife Conservation (Specially Protected Fauna) Notice 2005. Further the conservation status of the Night Parrot is endangered and migratory under the Commonwealth EPBC Act. This species is listed as migratory under the scientific name Geopsittacus occidentalis. How does this change in conservation status affect the results of the assessment? (Table 2) (Submission 5)***

Under the *Wildlife Conservation Act (1950)*, the Night Parrot is listed as Schedule 1 (rare or likely to become extinct) and is further assigned to the IUCN category of Critically Endangered. Under the *EPBC Act (1999)*, it is listed (as *Pezoporus occidentalis)* as Endangered and is further listed as migratory because of its inclusion under JAMBA as *Geopsittacus occidentalis*. This migratory listing is puzzling as there is no evidence to suggest the species is a migrant, particularly to Japan. This matter did not come up in discussions with DEH staff, but they have previously commented (not with respect to the Night Parrot) that the list of migratory species under the *EPBC Act (1999)* needs attention. However, confusion over its status does not affect the assessment made for the species with respect to the Cloud Break proposal. The Night Parrot Management Plan incorrectly states that the species is listed as Critically Endangered under both the *Wildlife Conservation Act (1950)* and the *EPBC Act (1999)*, so the EPBC listing is actually slightly less significant.

**4.9.8** ***Given the uncertain habitat requirements for the Night Parrot how is it possible to map its habitat? Figure 4 simplifies the habitat of this species to grasslands and shrublands of ranges, hills and hillslopes and fringes of samphire flats… However, it doesn't recognise the Triodia chenopod potential habitat which occurs in the creek and drainage lines, and flats and broad plains (which occur in proposed Project disturbance areas). Why is Minga Well, where the Night Parrot was recorded by Bamford Consulting Ecologists not indicated on the Figure as potential habitat? (Table 2) (Submission 5)***

The mapping shown in the PER simply records the meagre knowledge that existed about Night Parrot habitat. It is hoped that, with more observations from planned future survey work, the habitat requirements can be better defined. Minga Well is a watering point and may not represent 'habitat' as such.

See also response to 4.9.9.

**4.9.9** ***(Table 2) The PER states that mining is not proposed for any area of the Fortescue Marsh. However, ecotones of Spinifex/Chenopod do occur outside the 'main area of the Fortescue Marsh referred to in Section 2.9, including the proposed Project disturbance areas…Further, the conclusion that 'habitat loss will not occur as a result of the FMG mining operations' contradicts the extent of habitat for the Night Parrot mapped in Figure 4. Has the Night Parrot been recorded at the Fortescue Marsh? (Submission 5)***

The only reliable record of the Night Parrot is at Minga Well which is outside the Marsh, but along a nearby drainage line. On available information, the core habitat may be the spinifex/samphire ecotone, with other, possibly secondary habitat outside this area. Mining will affect some of these secondary habitats but they are widespread. With so little known about the Night Parrot, the importance of any habitat is poorly understood. The statement that no habitat loss will occur was referring to the spinifex/chenopod ecotone.

**4.9.10** ***The Night Parrot Management Plan does not present data to support the notion that the proximity to the Fortescue Marsh increases the potential for the indirect impacts on the Night Parrot through current land use, introduced species, lighting, fire regime or noise. Is disturbance to the edge of the Fortescue Marsh proposed? (Table 2) (Submission 5).***

There are no real data on how these factors might affect the Night Parrot, but impacts can be inferred or predicted based on historic observations and experience with other species, particularly with respect to pastoral activities, introduced species and fire.

FMG will not be disturbing the edge of the Marsh.

**4.9.11** ***Should a Night Parrot be found in the disturbance area, e.g. during vegetation clearance, construction or operations, what does FMG intend to do? (Table 2) (Submission 5)***

The sighting would be reported to authorities immediately and further disturbance within the vicinity would cease until the area can be investigated by zoologists**.**

**4.9.12** ***It is unclear how this Project can be "not expected" to have an impact on the Night Parrot when that taxa is so poorly understood. (Submission 8)***

Whilst it is acknowledged that little is known about the Night Parrot, the Cloud Break Project will not target the type of habitat that available information indicates is of importance to the Night Parrot (i.e. the samphire/spinifex ecotone). The Night Parrot management measures proposed by FMG will provide the opportunity to learn about and conserve the Night Parrot that has declined and appears still to be declining for reasons unknown.

## 4.10 STYGOFAUNA

**4.10.1** ***Would like to see quarterly (as opposed to biannually) sampling plan be implemented for the presence of stygofauna in the groundwater in the Project areas for the first two years prior to Project commissioning and if encountered appropriate management actions to ensure that they are not threatened as a result of the take of water from the area. Also strongly support the continuation of stygofauna monitoring throughout the life of the Project. (Submission 2)***

FMG is conducting biannual sampling, to look at seasonal (rainfall) variations on stygofauna populations and this sampling frequency is consistent with the approach employed by CALM. The initial background sampling will occur for a period of two years prior to borefield operations. As stygofauna populations have been identified in some of the monitoring bores (see Section 4.6.3 of the Cloud Break PER), FMG has committed to preparing a management plan which covers management strategies and a continued sampling programme during operations (refer to Appendix K of the PER).

**4.10.2** ***Biannual monitoring of stygofauna throughout the life of the Project is described as 'possible', whereas it should be something that FMG 'will' do. (Submission 8)***

The Stygofauna Management Plan developed for the Cloud Break Project (Appendix K of the PER) states that FMG will continue biannual sampling for an initial period of 2 years. After this time a long term management plan will be developed to the satisfaction of CALM. While the long term stygofauna sampling frequency for the Project has not been determined at this time, it is likely to be similar to the biannual frequency currently being undertaken by FMG.

**4.10.3** ***Has the nematode found at Minga Well now been fully identified? Have the two potential new species of Paramelitidae now been fully analysed? Why does page xxvi say that no stygofauna of significance were found? (Submission 8)***

The nematode has already been described to the lowest taxonomic group and no genetic testing will be carried out. The new species of Paramelitidae are currently with CALM awaiting DNA analysis. FMG is unsure how long this process will take. The PER states that "to date none of the stygofauna species recorded within the drawdown areas were considered to be of importance". The two potential new species of Paramelitidae were actually from Cook Bore which is a regional bore and this occurs outside the influence of the mine dewatering. Since the release of the PER, Paramelitidae Sp 2 has also been found in the Robe, Ashburton, Pt Hedland, DeGrey and Fortescue catchments. Paramelitidae Sp 3 has now also been found at Newman.

**4.10.4** ***Why has the calcrete aquifer close to the Marsh not been sampled when it is possible that stygofauna also occur there? (Submission 8)***

As stated on page 35 of the PER, the Wittenoom dolomite is not intersected by any bores in the area. The area the dolomite typically occurs is near the Marsh, where evidence suggests that the water is highly saline and therefore unlikely to host stygofauna. FMG will be expanding its stygofauna sampling programme in the near future, and there is the opportunity at this time to construct a bore into the dolomite.

**4.10.5** ***There is insufficient data to allow for informed comment on the conservation***

***significance of stygofauna within and outside the Project area. (Submission 10)***

During the development of the initial sampling plan, there was a lack of suitable bores which could be utilised for sampling. FMG has recognised this and will expand its current sampling programme during the next sampling round in January 2006. It is anticipated that 15 bores inside and outside the Project area would be added to the programme in consultation with CALM. It should also be noted that FMG has been monitoring around 24 regional bores.

**4.10.6** ***This Department is concerned about the methodology used and validity of results of the stygofauna sampling programme undertaken for the Cloud Break proposal (p. 35). Similar mineral projects in the Pilbara have been required to sample 15-20+ bores to ensure stygofauna has been adequately sampled. In this instance, the proponent sampled only 6 bores. (Submission 10)***

Refer to response 4.10.5.

**4.10.7** ***It was concluded in the PER that high levels of turbidity due to lack of casings is likely to have resulted in no fauna being recorded in 3 of these bores. Furthermore, 2 out of 3 of the uncased bores are in the pit dewatering zone where large drawdown may result in dewatering of stygofauna habitats (if they exist). (Submission 10)***

FMG has made the commitment to expand its sampling programme for Cloud Break, this will also include the casing of existing bores to reduce turbidity (see response 4.10.5).

## 4.11 REHABILITATION AND CLOSURE

**4.11.1** ***FMG should be required to demonstrate that when they are ready to relinquish control of the tenements that the disturbed land has been rehabilitated to a level that without further management the area within a reasonable period will return to self-sustaining functional ecosystems similar that which existed prior to the disturbance. This should be a Ministerial condition on the proponent relinquishing control of the tenements. (Submission 1)***

Commitment 6 in Table 27 of the PER states that FMG will "develop a comprehensive Mine Closure Plan which includes Closure Criteria to be agreed with the regulators" (refer to Appendix M of the PER). The Rehabilitation and Revegetation Management Plan in Appendix J of the PER, states that these closure criteria will be used as a basis for assessing the closure of the Project, with FMG required to be in compliance with the specified criteria before the land management can be relinquished. The closure criteria will be reviewed every two years with the Mine Closure Plan and updated to include findings of FMG's mine rehabilitation research and development programme as well as additional requirements of the regulatory authorities.

**4.11.2** ***Need to ensure that borrow pits are opened and rehabilitated in a timely manner, in coordination with the progress of the development of the mine and associated operations. Need to ensure the appropriate rehabilitation of any borrow pits. (Submission 2)***

FMG will ensure that borrow pits are opened and rehabilitated in a timely manner and ensure appropriate rehabilitation of any borrow pits. The Rehabilitation and Revegetation Management Plan (Appendix J) includes a draft Borrow Pit Rehabilitation Procedure.

**4.11.3** ***Strip mining is a very high impact, low return form of mining resulting in a massive footprint. Even if the pits are backfilled there are concerns with air voids and return of rejects and slurry. Need to ensure that the material is returned in the right percentage composition to try as far as practically possible return the soil profile to what is was originally. If mismanaged this has the potential to radically alter the soil profile/makeup and as such the organisms that will return to the area (both in soil and on top of soil). (Submission 2)***

Strip mining is necessary due to the orebody type, which consists of a relatively shallow ore seam covering a large area. This mining method offers an opportunity to restore most of the pit areas to their original topography. If FMG manages topsoil, overburden and beneficiation rejects correctly, there is a reasonable expectation that many of the ecological values that existed previously can be returned, over time, to these areas. FMG agrees that reconstruction of the soil profile is an important element in successful rehabilitation.

**4.11.4** ***Need to ensure that the pits are rehabilitated in a timely manner and using indigenous seed from the area. These will form significant barriers to not only surface water movement, but also faunal movement. (Submission 2)***

As stated in the Rehabilitation and Revegetation Management Plan (Appendix J of the PER), pits will be progressively rehabilitated following the initial start-up phase. The establishment of vegetation on the rehabilitated areas will rely on the seed source within the topsoil. However, where required, seeding with local native species will also be undertaken. Surface water diversionary works will be developed in stages as the pit is mined in stages, to minimise the barrier to surface water movement.

**4.11.5** ***Would like to see seed collection from the affected area take place prior to soil removal activities and use of local seed incorporated into the Rehabilitation and Revegetation Management Plan for the affected mining areas. (Submission 2)***

As stated in the Rehabilitation and Revegetation Management Plan, it is expected that revegetation will occur through recruitment from the topsoil seed bank. Opportunistic seed collection from vegetation prior to clearing may occur where the seed source warrants collection. If supplementary seeding is required, seed collection will occur in the general vicinity of the proposed revegetation areas.

**4.11.6** ***Re-establishment of native vegetation communities after mining to resemble as closely as practicable the original Mulga communities (p.xv). Arid environment (annual evaporation rates greatly exceed the mean annual rainfall (312mm at Newman)) therefore the Project area will be extremely difficult to successfully rehabilitate. (Submission 4)***

FMG will work to ensure that direct and indirect impacts on vegetation are kept to a minimum and believes that with appropriate research and rehabilitation trials, that disturbed areas can be successfully rehabilitated.

Rehabilitation trials will be undertaken throughout the life of the Project to investigate the likely success for revegetation using different methods, and addressing the issues of water relations, weed invasion, and changes in topography and soil structure. Investigations have been undertaken into rehabilitation methods used in Mulga communities in the Pilbara. This review has highlighted that with appropriate topsoil/overburden handling and seeding it is feasible to undertake Mulga rehabilitation in environments similar to the Project area (pers. comm. Mattiske, 2004). In the event that rehabilitation is unsuccessful in certain areas remediation works may be undertaken. This may include repair of eroded areas, weed control, and seeding or planting of areas where vegetation has not established from natural seed sources in the applied topsoil and mulch.

The rehabilitation programme will include development of rehabilitation and revegetation completion criteria in consultation with key stakeholders. Criteria will define when a rehabilitated area can be considered self-sustaining, or when it indicates a continuous positive trend towards a stable community. Regular monitoring will be carried out to determine rehabilitation success (Appendix J).

**4.11.7** ***What will the completion criteria be for restoring the 'biological diversity and ecological integrity' on completion of mining? How long will it take to achieve these criteria? Will the rehabilitated areas be able to be grazed by cattle? An enforceable condition or commitment should be included in the Cloud Break approval to clearly specify these requirements. (Submission 5 – Table 1)***

Commitment 6 in the Environmental Commitments Table (Table 27 of the PER) states that FMG will "develop a comprehensive Mine Closure Plan which includes Closure Criteria to be agreed with the regulators".

Draft completion criteria have been developed for the Project and are presented in Section 11 of the Conceptual Closure Plan (Appendix M of the PER). However, these are likely to be refined throughout the life of the Project. For example, changes may be made as a result of research into rehabilitation methods, ongoing baseline monitoring and increased environmental expectations placed on mining companies in general. It is not possible to determine at this stage how long it will take to achieve these criteria although it is acknowledged that the process takes longer in arid areas than where rainfall is more generous. However, FMG will continue to monitor environmental performance during decommissioning, rehabilitation and post-closure stages of the Project and take appropriate action until the approved completion criteria have been met.

The most likely post-mining land use of the rehabilitated areas is pastoral, with management of the land being returned to the pastoral leaseholders on completion of closure, decommissioning and rehabilitation. Affected pastoral leaseholders will be included in stakeholder consultation prior to the onset of closure, to facilitate discussion of closure planning.

**4.11.8** ***We do not agree with the following statement in Section 7.2.4 "As successful revegetation is key to the minimisation of impacts from land clearing…" The key to minimisation of impacts from clearing should be to restrict the amount of clearing for mining activities to the smallest area possible, not to rely on revegetation of mined areas. What is the proposed method for clearing vegetation for mining and how will it be minimised? (Submission 5 – Table 1)***

As stated in Section 6.2.1 of the PER, vegetation clearing will be kept to a minimum necessary within engineering and safety requirements. Areas that are already disturbed or cleared will be used for

laydown areas and temporary facilities where available. Clearing will be undertaken using standard practices for the mining industry such as initial clearing with a bulldozer and then a scraper (Refer to Appendix 1 of the Rehabilitation and Revegetation Management Plan; Appendix J of the PER). Topsoil and vegetation from pre-stripping operations will be used in progressive rehabilitation activities. FMG will have a clearing procedure and clearing limits will be marked on all design drawings and pegged in the field prior to any clearing works commencing.

**4.11.9** ***How will FMG determine that the revegetation of post mine landforms is a self-generating ecosystem? An enforceable condition or commitment should be included in the Cloud Break approval to clearly specify the minimum requirements for rehabilitation. (Submission 5 – Table 1)***

Commitment 6 in the Environmental Commitments Table (Table 27 of the PER) states that FMG will "develop a comprehensive Mine Closure Plan which includes Closure Criteria to be agreed with the regulators (refer to Appendix M for draft)".

As outlined in the Rehabilitation and Revegetation Management Plan (Appendix J of the PER), FMG will develop a set of completion criteria against which revegetation post mining landforms will be assessed to determine if they have reached a self sustaining ecosystem. The completion criteria will be reviewed every two years with the closure plan and updated to include findings of FMG's mine rehabilitation research and development programme as well as additional requirements of the regulatory authorities. Refer also to response 4.11.7.

**4.11.10** ***Is this commitment to rehabilitate such that the site will resemble pre-mining conditions realistic? Has it ever been achieved in comparable ecosystems before? What bond is contemplated to ensure this commitment is met in the event that FMG is liquidated or the tenements are on sold to a company that goes bankrupt? (Submission 8)***

All rehabilitation will be required to meet completion criteria developed in consultation with, and approved by, the State Government. In addition to maintaining the values of native vegetation wherever possible, FMG will seek to minimise its future rehabilitation liability by minimising clearing to that absolutely necessary. FMG has a strong incentive to limit clearing wherever possible due to the operational costs associated with both clearing and rehabilitation. FMG will be required to submit bonds for disturbance and this is currently being negotiated with DoIR.

**4.11.11** ***It is also fair to say that to the extent that parts of the Project area have been heavily impacted by grazing, a commitment to merely return them to that (poor) condition does not amount to much. (Submission 8)***

All rehabilitation will be required to meet completion criteria developed in consultation with, and approved by, the State Government. These criteria are unlikely to target a heavily grazed vegetation condition but rather would seek to achieve the equivalent of a vegetation characteristic of good rangeland condition.

**4.11.12** ***Impacts from the proposed operations are likely to result in an ongoing liability for FMG to manage on a long-term basis well past mine closure and could potentially become a liability to the State Government. Issues such as weeds, alteration to natural***

> ***surface drainage patterns, prolonged groundwater drawdown, habitat clearance, and the creation of artificial water sources will all need to be addressed in mine closure. Given the clear intention for the tenure of the land to be converted to a conservation reserve in 2015, this Department is concerned about these ongoing liabilities. (Submission 10)***

The requirement for management by FMG of the Cloud Break operation after the cessation of mining and processing is acknowledged and, in this respect, it is no different to many other mining operations in Western Australia. The Conceptual Plan for Mine Closure was included as Appendix M of the PER. The Plan outlines the overall approach to mine closure and provides for extensive consultation in the period leading up to mine closure. All of the issues listed above, and many other issues, will be considered in mine closure planning and implementation.

# 5. POLLUTION

This section summarises and addresses concerns about potential pollution from the Project that were raised in the submissions.

## 5.1 AIR - DUST

### 5.1.1 *Marra Mamba ore type is extremely dusty material, to the extent that fines resemble a talc powder. Would need to ensure that during transport and activities at the port facilities that the appropriate level of moisture is added so as to prevent generation of excess dust. (Submission 2)*

The issue of dust control at the port facilities was covered under the Stage A PER. FMG recognised in the Stage A PER that "one of the most critical elements in minimising dust emissions from the FMG Project is the maintenance of the moisture content of the ore above an optimum threshold". To ensure this occurs, FMG has committed to an "integrated ore moisture monitoring and management system". This system shall incorporate:

- testing different ore types to determine their specific optimum moisture content;
- monitoring of dust and moisture levels of ore; and
- adding water via sprays as required.

FMG is prepared to coordinate its dust monitoring and management activities with existing and future port users.

### 5.1.2 *The FMG Cloud Break PER describes three potential mining methods and related crushing and screening facilities required for use in the Cloud Break mine area prior to ore transport. It is uncertain whether the dust assessment has included the crushers. Crushers are understood to be significant dust sources within any mining operation.*

*This creates uncertainty regarding the potential dust emissions from the Cloud Break mine operation and therefore uncertainty regarding the Project's ability to operate within the relevant air quality criteria and an uncertain basis for any cumulative impact assessment required for other Projects in the region. (Submission 6)*

The dust assessment considered the potential impacts from crushing and screening (refer to Section 6.8 of the PER). Management of the potential impacts from this and other sources will be addressed in a Dust Management Plan.

### 5.1.3 *A recent visit by CALM personnel to the proposed Cloud Break site indicated that dust generated from regular vehicular use of dirt tracks for exploration activity is already a significant environmental issue. Although it is acknowledged that natural background dust levels are high within the Project area, it is imperative that the proponent ensures that dust avoidance and suppression measures are adequate in order to minimise the impacts of dust on vegetation. (Submission 10)*

FMG is aware of the importance of dust control on its mining tenements. During exploration activities FMG has utilised two water trucks to wet down road surfaces in order to control dust. Although FMG believes that this technique has been successful in significantly reducing dust levels during

exploration, they are committed to further improve on this technique during construction and operation of the Cloud Break operations. In the Cloud Break PER, FMG has committed to:

- use of water trucks on high traffic areas;
- minimising vegetation clearing and rehabilitating cleared areas no longer required for construction or operations;
- optimising vehicle movements;
- daily visual inspections of construction areas and active mining areas to ensure that dust control methods are implemented and effective;
- regular assessment of the condition of vegetation and dust deposition; and
- ambient dust monitoring where appropriate.

FMG believes that these measures shall be sufficient to protect vegetation.

**5.1.4** ***It is uncertain what will be used as a 'trigger' for determining whether "additional dust suppression measures (such as water sprays on haul roads and loading stockpiles) will be implemented if other dust avoidance and management measures are insufficient" (p. 79). (Submission 10)***

As with all mining ventures in the Pilbara, FMG believes that the primary concern in regards to dust is safety. However, FMG recognises that dust can potentially affect vegetation by deposition on leaves, consequently reducing the ability of vegetation to carry out photosynthesis and transpiration. FMG has set the trigger level for "additional dust suppression measures" as visible dust.

**5.1.5** ***We note that no studies have been done as to the impact of dust on vegetation. More work is required before the Project should be further considered for environmental approval, or alternatively estimates of vegetation loss should be reworked to factor in dust-related damage. (Submission 8)***

FMG notes that the Pilbara is well recognised as a dusty environment. FMG believes that by implementing the dust management procedures mentioned in 5.1.3, dust output from the operation shall not be significantly higher than background levels. As part of these measures, FMG will regularly assess vegetation health. FMG believes that these measures will be sufficient to ensure that the surrounding vegetation is protected.

## 5.2 AIR – GREENHOUSE GAS

**5.2.1** ***Would like to see renewable energy sources promoted throughout the Project to help meet energy needs (as opposed to use of fossil fuels), though appreciate emphasis on energy efficient technology, would also like to see the promotion of renewable energy sources throughout. (Submission 2)***

In section 6.7 of the Cloud Break PER, FMG will use renewable energy wherever practicable (e.g. solar panels).

Once operational, FMG has committed to monitor greenhouse gas emissions and continue to look for ways to improve energy efficiency and reduce greenhouse gas emissions as part of its continual improvement programme.

**5.2.2** ***The estimated greenhouse gas emission rate for the FMG Stage A and B projects differs considerably between the estimations detailed in the Cloud Break PER and those detailed in the Stage B PER. It is therefore not possible to determine the rate of greenhouse has emissions to be considered when assessing the cumulative impacts of these projects. (Submission 6)***

Project changes have resulted in the removal of the Mt Nicholas and Mt Lewin mines and significantly reduced the length of the proposed railways. These changes reduce the proposed area of clearing and the distances travelled by locomotives (and their fuel consumption) resulting in a reduction in the expected greenhouse gas emissions. The revised greenhouse gas emission calculations are shown in Table 16 of the Cloud Break PER.

**5.2.3** ***Although we oppose the Project as currently contemplated, it is clear it could be made more palatable if FMG was to fund biosequestration sufficient to deal with all of the Project and post-project emissions discussed here. (Submission 8)***

FMG will aim to offset a portion of its greenhouse gas emissions through the progressive rehabilitation of disturbed areas. FMG's offset package has been developed in consultation with the DoE and CALM to maximise the benefit to the areas affected by the Project. FMG does not believe that biosequestration would provide the local area more benefits than the offsets proposed. However, FMG will aim to minimise Greenhouse Gas emissions by the following mechanisms:

- minimising clearing;
- optimisation of vehicle movements; and
- use of energy efficient technology where possible.

**5.2.4** ***This Department believes there are opportunities to offset greenhouse gas emission through purchasing land for conservation (through managing wildfire and improving vegetation condition) and through the provision of funds to help manage and reduce wildfire in the Pilbara. This Department would be pleased to engage in discussions on potential greenhouse gas offset options. (Submission 10)***

FMG has committed to aiding in the protection of the Fortescue Marsh through the formulation of the Fortescue Marsh Management Plan, funding of research, and funding a full time CALM position to manage the Marsh. FMG believes that these offsets will provide significant assistance towards understanding and managing local conservation values. FMG will seek to minimise greenhouse gas emissions through other strategies. FMG will also be preparing a Fire Management Plan for the Stage B and Cloud Break operations to reduce the risk of unplanned wildfires.

## 5.3 NOISE

**5.3.1** ***There are differences between the FMG Stage B and FMG Cloud Break Projects Predicted noise level at the Fortescue Marsh. In addition, the receivers upon which the modelled noise levels are based, differ between the Cloud Break PER and the Stage B PER. This therefore creates uncertainty as to the extent of the potential noise impacts and creates some confusion over the nature and location of the sensitive receivers associated with the FMG Stage B Project rail line alignment. (Submission 6)***

There will be some differences in the noise impacts on the Fortescue Marsh from the Stage B and the Cloud Break Project as each of these projects are located different distances from the Marsh and have different layouts which affect noise emissions. The Cloud Break Project is located further west and north of the Stage B Project. Therefore, some of the receptors modelled for Stage B to the east (Bonney Downs and Noreena Downs) and south (Roy Hill and Ethel Creek) will not be affected by the Cloud Break Project. As outlined in Section 6.14.6 of the Cloud Break PER, the noise impacts of the revised railway alignment were remodelled. No significant impacts were identified.

**5.3.2** ***The FMG Cloud Break PER describes three potential mining methods and related crushing and screening facilities required for use in the Cloud Break mine area prior to ore transport. It is noted that the FMG Cloud Break noise assessment does not include crushers within the mine areas and it is therefore assumed that the noise assessment has not included these as operational noise sources. Crushers are understood to be significant noise sources within any mining operation.***

***This creates uncertainty regarding the potential noise emissions from the Cloud Break mine operation and therefore uncertainty regarding the Project's ability to operate within the relevant noise criteria and an uncertain basis for any cumulative impact assessment required for other Projects in the region. (Submission 6)***

The noise assessment did include an assessment of the potential noise impacts from crushing and screening (refer to Table 4.2 for noise sources considered in the Noise Assessment Report, Appendix N of the PER).

**5.3.3** ***How will the effects of blast noise on fauna in the Marsh be achieved? How were the potential effects when the Marsh is in flood modelled? (Submission 8)***

FMG acknowledges that the environmental impact assessment indicates there is some potential for disturbance of bird populations at the Fortescue Marsh from blast noise. Noise modelling undertaken for the environmental impact assessment suggests that blast noise occurring at the nearest points within the Fortescue Marsh area will approximate 139 dB for surface blasting, reducing to 115 dB for 'in pit' blasts (Table 18 of the Cloud Break PER). These levels comprise primarily low frequencies and, as such, bird populations might be expected to quickly habituate to them. However, FMG committed in the PER (Sections 6.9.2 and 6.9.3) to monitor impacts, if any, on birds utilising the Marsh during breeding times.

FMG has also identified some options for reducing potential impacts that can be implemented during breeding times. These options include the selection of optimal meteorological conditions to undertake blasting and the potential modification of blasting practices, should this appear necessary. With

regard to the impact of noise on the Night Parrot or any other fauna, FMG would be prepared to consider modifications to blasting practices on a case-by-case basis, should it appear that significant adverse impacts could occur.

**5.3.4** ***Apart from avoiding worst case meteorological conditions, blasting should also be avoided at times of the year when:***

- ***herpetofauna are breeding; and***
- ***birds using the Marsh are breeding. (Submission 8)***

Refer to response 5.3.3.

**5.3.5** ***The importance of the marsh for water birds is underestimated, and the extent to which noise from blasting and disturbance from mining and related activities will potentially impact upon avian fauna of high conservation significance is not adequately addressed. (Submission 10)***

Refer to response 5.3.3.

**5.3.6** ***Once the mine is approved limited management action will be available to minimise the impact of mine blasting noise and other activity disturbance on waterbirds and other significant avian fauna i.e. migratory birds and potentially Night Parrots. (Submission 10)***

FMG has committed to developing a Fortescue Marsh Management Plan, a Night Parrot Management Plan, and a Fauna Management Plan, in consultation with CALM and DoE. These plans will describe specific management actions relevant to each issue. Management of each of these issues will be reported annually to government.

Also refer to response 5.3.3.

**5.3.7** ***CALM recommends that further study is required ahead of major blasting so the proponent can demonstrate that the risk of impact on avian and other fauna, especially the Night Parrot and migratory waterbirds, from blasting noise is low. (Submission 10)***

Refer to response 5.3.3.

## 5.4 ACID MINE DRAINAGE

**5.4.1** ***Would like to see comprehensive testing for Roy Hill shale and salt water intrusion potential before each strip is mined. (Submission 2)***

***AMD monitoring should presumably also include ore tests to check whether Roy Hill shale is successfully being avoided at all times. (Submission 8)***

FMG's operations will not extend into the Roy Hill shale. In general, around 20 m of non-mineralised Marra Mamba formation separates the Roy Hill Shale and the latter is not viable to mine. Grade

control drilling will be carried out for the life of the Project and subsequent block modelling will ensure that the Roy Hill shale does not feature in mining operations. Periodic monitoring and sampling for AMD will be carried out to update the current understanding.

The possible intrusion of salt water will be monitored as outlined in response 4.5.3.

**5.4.2** ***Pages 123 and 124 this section expresses significant uncertainty regarding the potential for Acid Mine Drainage because of the intersection between Roy Hill shale and the cone of groundwater depression. Considerably more data collection and monitoring are required before the Project should be further considered for environmental approvals. (Submission 8)***

There is a degree of uncertainty of the potential for AMD to be generated by in-situ dewatering of PAF (potentially acid-forming) material as to date AMD research has only focused on material extracted by mining. For this reason, FMG has committed to carrying out further investigatory work if monitoring suggests that the Roy Hill shales are within the groundwater cone of depression. The further work would include oxygen diffused modelling and monitoring which would be required to assess the magnitude of localised pyrite oxidation.

# 6. SOCIAL

This section summarises and addresses social issues that were raised in the submissions.

## 6.1 STAKEHOLDER CONSULTATION

**6.1.1** ***We do not consider that we have been consulted in any meaningful way concerning the Cloud Break proposal. In light of our experiences to date we are concerned that adequate consultation will not occur in the future. FMG has ignored most of our requests for consultation and has proceeded to commence the preparation of a trial pit and airstrip on the pastoral lease even though we have declined to give our consent. (Submission 5)***

FMG has contacted and consulted with Mulga Downs Station on any issue relevant to the management of their station. A record of consultation with Mulga Downs Station and associated entities is presented as Appendix C. Recently, FMG were advised that the Mulga Downs Partnership (MDP), based in Perth, would be taking control of communications with FMG. FMG has not ignored requests for consultation and remains amicable to discussing MDP's concerns and to try and resolve differences. FMG has made a number of recent attempts to meet and discuss MDP's concerns, however, MDP has not reciprocated.

**6.1.2** ***The Cloud Break PER offers little information as to the potential impact of FMG's activities on our pastoral lease. This lack of information, together with FMG's continued lack of consultation, means that we are unable to properly assess the impact of the Cloud Break PER on our pastoral activities. (Submission 5)***

The Cloud Break PER is intended to fulfil obligations required by the *Environmental Protection Act 1986*. The level of detail in the PER is consistent with other PER's prepared for similar Projects in the Pilbara. Consultation with Mulga Downs has included personal visits to discuss the proposal, access for scientific surveys and notification in writing of FMG's activities within Mulga Downs Station that potentially were of interest or that may affect activities at Mulga Downs. A list of consultation undertaken to date with Mulga Downs is included as Appendix C. FMG suggest that the Mulga Downs representatives contact FMG to discuss concerns they have.

**6.1.3** ***The Cloud Break PER also anticipates that a community consultation and stakeholder engagement programme will be prepared and implemented by FMG. Beyond an ambiguous reference to the programme consisting of an "on-going open door approach", no further information about FMG's consultation strategy is provided. (Submission 5)***

Further detail on FMG's consultation strategy is presented in Appendix D.

**6.1.4** ***The Cloud Break PER also states that FMG encourages members of the community to contact FMG and "be advised of the Cloud Break Project and the possible effects it may have on them". It does not provide for stakeholders to have any input into the ways the Project may be implemented so as to minimise the impact and interference with stakeholder rights and interests. Furthermore we are concerned that in the light of FMG's lack of response to concerns raised, FMG will not respond to community responses despite assurance in the PER. (Submission 5)***

Section 7 of the Cloud Break PER outlines the consultation that was undertaken during the environmental impact assessment process. The purpose of the consultation was to keep stakeholders informed and to take into account their concerns in developing the Project. Section 7 also summarises the main concerns raised. The consultation process, however, is ongoing (see Appendix D) and extends to any issues of concern, not just the environmental issues that are the subject of this review.

**6.1.5** ***While FMG has briefly visited the station manager, who gave no consents and referred FMG to our Perth office, there has been no consultation with the pastoral leaseholder. The initial correspondence we received from FMG amounted to little more than notification that FMG would be carrying out exploration on Mulga Downs Station. (Submission 5)***

A comprehensive list of consultation undertaken by FMG with Mulga Downs is attached as Appendix C. While every effort is made to ensure that concerns of all parties are considered, FMG cannot carry out effective consultation if a stakeholder refuses contact. FMG has offered to meet with the submitter on a number of occasions and remains willing to discuss their concerns.

**6.1.6** ***In spite of various correspondence from ourselves to FMG raising concerns about the Cloud Break proposal, the first written response came in a letter dated 17 October 2005 (received on 19 October). In this letter FMG acknowledged its tardiness in responding to our correspondence. The sequence of correspondence included the following:***

- ***FMG wrote to the station manager by letter dated 29 August 2005 advising of its intention "to conduct a trial mining exercise within Mulga Downs pastoral lease". This letter was sent via the Tom Price mail bag and not received by the leaseholder until 16 September 2005;***
- ***We replied by letter dated 16 September 2005 advising that we did not consent to trial mining and requesting FMG to contact Mulga Downs' Perth office;***
- ***FMG wrote to the station manager via the Tom Price mail bag by letter dated 12 September 2005 advising that the Cloud Break PER would be available for public comment until 24 October 2005. This letter was delivered (by hand) to the station manager on 4 October 2005 thereby compromising our ability to respond;***
- ***On 13 October 2005 we wrote to FMG advising of their additional responsibilities in relation to the Fortescue Marsh and requesting responses to previous correspondence; and***
- ***FMG wrote to us by letter dated 17 October 2005 (received 19 October) advising that it now had "the necessary approvals which would enable it to commence the trial open pit" (Submission 5)***

A comprehensive list of correspondence between the Mulga Downs Partnership and FMG has been included as Appendix C. FMG has consulted and informed Mulga Downs of Project developments and studies since March 2004.

**6.1.7** ***Although in the letter of 17 October 2005 FMG offered to address our concerns and to meet us, the reality is that FMG's exploration, the construction of roads, an airstrip and living accommodation and the preparation of the trial pit are proceeding at a pace which will not allow for any reasonable consultation with us. Indeed, FMG has ignored our refusal to consent to the trial pit. (Submission 5)***

See response to 6.1.8.

**6.1.8** ***A letter dated 29 August 2005 advised that blasting is unlikely at the trial pit. In contrast to this statement the enclosed photos of FMG signage at Mulga Downs station indicates that blasting is anticipated. These inconsistencies and uncertainty heighten our concerns and emphasise the need for adequate consultation prior to further invasive mining activity. (Submission 5)***

Trial mining was not a component of the Cloud Break PER assessment. The trial is part of FMG's exploration activities and was submitted to the DoIR and assessed as a Notice of Intent. Comment on the trial, including blasting procedures, has been received and approved by appropriate government agencies.

There is no discrepancy between the letter sent to Mulga Downs and the signage photographed. FMG believed at the time of the letter dated 29 August 2005 that it was unlikely that blasting would be required during the trial mining, however decided to take a cautious approach and inform visitors and staff to anticipate that blasting may occur. However, since commencement of the trial pit on Friday 28 October 2005, it has become apparent that blasting will be required. A licensed contractor has been conducting all blasting at the trial pit in accordance with regulatory requirements and addressing safety concerns. Mulga Downs Station was contacted at 10.20am on Sunday 6 November, prior to commencement of blasting, to notify them that it would be occurring.

**6.1.9** ***The PER also notes that: "FMG will liaise with affected land holders regarding impacts on land access and land use. Management measures may include additional fencing and gates, cattle crossings, and land use agreements." The PER does not detail when and how FMG will liaise with affected land holders, including ourselves. In any event, stakeholders will have no recourse to formal public review processes at the time they are informed of management measures to be imposed by FMG. (Submission 5)***

The consultation process with affected land holders is outlined in Appendix D of this report. This process is ongoing. FMG is currently carrying out a detailed feasibility study for the Project and the bulk of consultation regarding land access and land use impacts will occur once project specifics have been determined. Notwithstanding, FMG would welcome requests for information at any time. FMG will take into consideration the concerns of affected land holders during development of management measures for land access and land use.

**6.1.10** ***The Cloud Break PER provides in relation to many significant environmental aspects of the Cloud Break PER that ongoing stakeholder liaison will enable FMG to further access potential risks and opportunities and mitigation measures. However, the PER does not establish a strategy for ongoing stakeholder liaison nor future opportunities for stakeholders to be informed about FMG's operations. Moreover, it is our experience to date that FMG will push ahead irrespective of our concerns. (Submission 5)***

FMG's consultation strategy is attached as Appendix D. FMG would be willing to set up a stakeholder group that meets regularly if the submitter feels this would be of benefit.

**6.1.11** ***Most importantly, the public review process is the only opportunity we will be given to raise our concerns about the impact of FMG's Cloud Break proposal on our pastoral activities. However, the Cloud Break PER does not provide us with sufficient information to adequately assess the risk to our operations. (Submission 5).***

FMG is committed to ongoing consultation process and affected stakeholders will have the opportunity to raise their concerns throughout the life of the Project. It is FMG's desire to limit its impacts on all pastoral holders, as much as possible.

The Cloud Break PER adequately describes FMG's range and extent of proposed activities, and further detail will be provided following the detailed feasibility study. FMG has not received a request from this submitter for further specifics in regards to the proposed operation. If the submitter requires more detail in order to assess the risk to its operation, FMG would welcome the request, and will endeavour to provide any information required.

**6.1.12** ***The first opportunity we were given to comment on the Cloud Break mining proposal was when the PER was exhibited on 12 September 2005. We do not believe that the lack of consultation is acceptable considering the scale of the proposed mining project and the fact that it would directly impact Mulga Downs station. (Submission 5 – Table 1)***

FMG commenced consultation with Mulga Downs in March 2004, regular updates of the Project have been provided since this time. A list of consultation with Mulga Downs is presented as Appendix C***.*** A letter was also sent in July 2005 informing Mulga Downs Station that the proposed Cloud Break Project had been reviewed by the EPA and a level of assessment of PER determined. A scoping document on the Cloud Break Project was also forwarded to Mulga Downs Station at this time.

**6.1.13** ***Surely FMG has no right to erect fences, gates etc on Mulga Downs station without speaking to the lessees first? Can an enforceable condition or commitment be included in the Cloud Break approval which requires consultation beforehand and a requirement that all relevant management measures that could affect Mulga Downs station be approved by the lessee before they happen? (Submission 5 – Table 1)***

FMG will liaise and consult with all relevant stakeholders (including Mulga Downs) to ensure its Project is progressed in a mutually agreeable manner. FMG agrees that Mulga Downs should be consulted in regards to any management decisions that could affect Mulga Downs station. Construction of fencing and gates on Mulga Downs Station would only occur to ensure cattle are

excluded from operating mine areas for the protection of the cattle and the safety of the general public and mine workers.

**6.1.14** ***The PER does not provide any details of the level of 'restriction' mentioned in Section 5.4.6 of the PER that would be placed on working in the vicinity of the mine site. It talks about 'their activities' affecting the Project, but not the other way around. This is a concern as we need to know to what extent our pastoral activities would be affected. (Submission 5 – Table 1)***

There would be restrictions imposed on entering active mining areas. This is not an operational restriction but to protect the safety of personnel not inducted or aware of safety requirements of the site. FMG understands that its activities will have an effect on land access and land use for pastoral owners, including Mulga Downs, and has committed to discussions on how to mitigate these issues.

## 6.2 IMPACT ON PASTORAL ACTIVITIES

**6.2.1** ***The Cloud Break PER acknowledges that the Cloud Break Project affects Mulga Downs Station…This acknowledgement is qualified by FMG's statement that "it is common in the East Pilbara for mining companies to hold pastoral leases to ensure security of access to land adjacent to mines and infrastructure." This statement suggests an indifference to the impacts on pastoral lessees despite the real concerns already raised in various correspondence to FMG. (Submission 5)***

FMG's intent of the statement was not to show indifference to the impacts on the pastoral lessees of mining, but to state the fact that pastoral activities and mining can and do co-exist in the East Pilbara. It is FMG's hope that this can be achieved between Mulga Downs and Cloud Break Project with benefits for both parties.

**6.2.2** ***The Cloud Break PER states that the Project has the potential to impact on pastoral leases by limiting stock movements, minimising access to pasture, and compromising vehicle access on the pastoral station. The management strategy identified to control this impact is for FMG to continue liaising with affected pastoralists. The PER does not adequately identify in what way stock movements or access to pasture or vehicle access may be limited. In these circumstances, it is impossible for us to assess the impact of the Project on the pastoral operations conducted by the lessee. (Submission 5)***

Specific areas that may be restricted to access have not at this time been precisely defined; however it is likely that restrictions will be imposed on entering active mining areas. This is not an operational restriction but to protect the safety of personnel not inducted or aware of safety requirements of the site. FMG understands that its activities will have an affect on land access and land use for pastoral owners, including Mulga Downs, and has committed to discussions on how to mitigate these issues.

**6.2.3** ***FMG's management strategy in relation to pastoral activities also states that on the completion of mining, public access will be restored except where the risk to the public would be unacceptable… The PER does not identify the likelihood of this occurring nor identify those areas where it is anticipated access may not be able to be restored. (Submission 5)***

FMG expects all areas to be rehabilitated and made available to the public at the completion of mining. However, FMG recognises that, for a variety of reasons, some of the areas on completion of mining may be considered unsafe. FMG is not able to speculate on any specific reason as to why this would occur, but feels it important to recognise the possibility.

**6.2.4** ***The permanent loss of access to parts of Mulga Downs station may have a significant impact on our ability to conduct pastoral activities. The PER does not enable us to assess this risk to its operations. (Submission 5)***

FMG considers it extremely unlikely that any permanent loss of access to parts of Mulga Downs station will occur. Areas of Mulga Downs which would be affected by the proposal are shown in Figure 2 of the PER. The proposed mining schedule is presented as Figure 15 of the PER. FMG is willing to discuss these matters with Mulga Downs to ensure a mutually acceptable outcome. The mining to occur on Mulga Downs Station is temporary in nature and should not result in any permanent exclusion to parts of the station. Significantly more area will be excluded from the station on a permanent basis as a result of the 2015 pastoral lease negotiations with CALM.

**6.2.5** ***The Cloud Break PER provides for the construction of access roads to the Cloud Break mine site as well as to support infrastructure. All roads are proposed to be at least 7 m wide and unsealed. The PER does not provide any details of the location proposed for the construction of those roads. As the locations of the roads have not been advised, it is impossible for us to identify the impact the construction of the roads may have on our activities and cattle. The construction and use of roads can have a significant impact on cattle grazing. (Submission 5)***

Section 5.4.6 of the PER states that access to the Cloud Break Project area will be via a road along the Newman-Port Hedland Highway and then eastwards along a new track or upgraded pastoral track. Proposed transport corridors within the Cloud Break Project Area are shown on Figure 3 of the PER. FMG acknowledges that the construction and use of roads can have a significant impact on cattle grazing and will work with the leaseholder to ensure these roads have minimal impact on pastoral activities.

**6.2.6** ***The table in Section 3 states "FMG will consult with relevant stakeholders to investigate a cattle management programme in potential Night Parrot habitat to minimise habitat degradation." The lessee has not been consulted with regard to proposed modification to cattle management on the Mulga Downs station. Likewise the lessee has not been consulted with regards to proposed modification to current vehicle access arrangements or prescribed burning/fire management proposed on the Mulga Downs station (Table 2). (Submission 5)***

FMG is yet to develop the cattle management programme. However, when FMG does embark on developing this programme, a reference group will be established and the programme will be developed in conjunction with all relevant stakeholders including Mulga Downs lessee.

# 7. OTHER

This section summarises and addresses other issues that were raised in the submissions.

## 7.1 ASSESSMENT UNDER THE ENVIRONMENTAL PROTECTION ACT (1986)

**7.1.1** ***As the viability of the Cloud Break Project relies on the approvals of both Stage A and B, the Society does not agree that the Cloud Break proposal should be considered separate from the other proposals (PER p.ix). The potential impacts of Stage A and B proposals must also be considered by the Environmental Protection Authority (EPA) in the environmental review process. The Society believes having all three proposals considered separately could compromise the overall values of the Chichester range. (Submission 4)***

In Section 6.14 of the Cloud Break PER, FMG discusses the potential cumulative impacts of the Project in relation to other projects within the region, in particular FMG's Stage B Project. FMG believes that due consideration of the cumulative impacts of FMG's projects has been made. Development of appropriate management measures to address these impacts will not compromise the overall values of the Chichester Range.

**7.1.2** ***The Region notes that FMG has advised the Department that they have constructed a number of bores and commenced pump testing and taking water without holding the relevant licences under the Rights in Water and Irrigation Act 1914. Additionally FMG has recently constructed two landfills, one at Cloud Break and one at Christmas Creek without applying for a works approval or clearing permit. The Cloud Break landfill was constructed on a tenement that FMG had not attained legal access to. These matters are being followed up by North West Region. (Submission 7)***

FMG does not agree with all of these claims, but has been and will continue to work with the relevant agency to ensure their resolution. The issues raised do not relate directly to assessment of the Cloud Break Project under Part IV of the *Environmental Protection Act 1986*.

**7.1.3** ***The PER contains ambiguous statement such as:***

- ***FMG will implement blast management procedures where appropriate which may include (PER p121 sect 6.9.2);***
- ***…these may include (PER p117 sect 6.8); and***
- ***Renewable energy sources will be used where appropriate (PER p116 sect 6.7);***

***These statements are non-committal in the context of a document outlining how the proponent will carry out their Project. While it may be impossible to specify exact management actions at this stage, commitment to a suitable methodology of assessing options is a reasonable approach. (Submission 7)***

A consolidated list of commitments made by FMG is included as Section 8 of the PER. Many of the management plans to which FMG has committed will need to be developed in consultation with State Government agencies, including CALM and DoE. While some of the detail of the environmental management measures to be implemented are not available at the PER stage, FMG will need to satisfy these agencies that the detailed measures are acceptable.

**7.1.4** ***Public information released by FMG (including an announcement costing the definitive feasibility study to Australian Stock Exchange on 2 Aug) describes a revised railway alignment, and removes three smaller orebodies (Mt Nicholas/the Hammer, Mindy Mindy and Mt Lewin) from the company's intended mining operations. The Cloud Break spur line is being proposed on a new alignment, but may not have been submitted for EPA review. The EPA needs to be able to assess the Project in the form in which it will be operated (described in the definitive feasibility study), and the public should expect the same opportunity. The proponent should be required to submit an additional summary document to advise the licensing authorities (EPA and the Departments of Environment and Industry and Resources) which components of the Stage A, Stage B and Cloud Break Projects will finally be activated. (Submission 9)***

On the advice of DoE, FMG has prepared a summary document which describes the changes in Stage A and Stage B and the interaction between the two and Cloud Break (Appendix B).

**7.1.5** ***The Branch is concerned also that the public review document (the PER as submitted) does not allow for public comment on the detailed issues of groundwater management of the Project as most recently planned. (Submission 9)***

The PER outlines the proposal, the existing environment, and the proposed environmental management actions of FMG. It is not intended to detail specifics relating to groundwater abstraction, but an overall view of the relative impacts on a project scale. FMG believes the PER provides the public with sufficient information to assess groundwater management in these terms. In terms of the specific groundwater issues relating to individual bores, FMG shall apply for groundwater licences under section 26D of the *Rights in Water and Irrigation Act 1914* and more detailed information will need to be supplied at that stage.

See also response to 4.2.16.

**7.1.6** ***The proponent has not reasonably demonstrated it will be able to adequately avoid, minimise or mitigate the impacts of the proposed mine site in order to achieve a 'no net loss' outcome. (Submission 10)***

As stated in the PER, it is FMG's belief that the Project can be managed in an environmentally responsible manner. FMG has conducted extensive biological surveys in the vicinity of its Project and will continue to conduct surveys to increase understanding of the environment. In addition, FMG believes that the development of appropriate management plans and procedures, produced with the input from key stakeholders such as CALM and the DoE, will mitigate any potential detrimental aspect of the activity so that the Project can deliver a no net loss outcome. FMG has also committed to an extensive offsets package incorporating research, management measures and land acquisition to provide conservation benefits to Western Australia (refer to Section 3 of this document).

## 7.2 CUMULATIVE ENVIRONMENTAL IMPACTS

**7.2.1** ***The environmental impact of the Cloud Break Project can only properly be assessed if the proposals for Cloud Break and FMG's Christmas Creek Project are clearly described and the cumulative effect of both projects in their current form is assessed together. (Submission 3)***

Appendix B of this document clearly describes the revised Stage B (Christmas Creek) Project and how this relates to the Cloud Break Project. FMG has also considered the cumulative effects of both the Cloud Break Project and the revised Stage B Project in Section 6.14 of the Cloud Break PER. In this section, FMG has assessed the proposed total areas of disturbance, cumulative impacts on mulga communities, threatened fauna and flora, future conservation areas, water resources, stygofauna, Fortescue Marsh catchment, greenhouse gas emissions, and noise.

**7.2.2** ***Concern that the cumulative environmental issues in relation to both Christmas Creek and the submitter's Roy Hill Project cannot adequately be assessed unless the interaction of Cloud Break and Christmas Creek is clarified and understood. (Submission 3)***

Since the release of the Stage B PER, FMG has significantly simplified the Project. Appendix B clarifies all aspects of FMG's projects and explains the interaction between the Cloud Break and Stage B proposals.

**7.2.3** ***In response to concerns already expressed by the submitter about the revised Stage B proposal, the EPA advised by letter dated 27 July 2005 that it only intends to report on the "current aspects of the proposal which do not extend east beyond Christmas Creek". However, it is unclear which parts of the proposal in relation to Christmas Creek remain current and what cumulative effects those proposals and the emergence of Cloud Break may have. (Submission 3)***

Appendix B provides a clear description of the revised Stage B Project. Section 6.14 of the Cloud Break PER discusses the potential cumulative effects of the Cloud Break Project and the revised Stage B Project.

**7.2.4** ***The Stage B PER assessment will not take account, or properly assess, the cumulative impact of the current Cloud Break and Christmas Creek proposals. In the circumstances, it appears that material aspects of the Stage B PER have become redundant. (Submission 3)***

***Even if the Cloud Break PER and Stage B PER are jointly considered, the cumulative impacts of both projects cannot be accurately assessed. The Stage B PER is no longer reflective of FMG's proposal for the development of Christmas Creek. Accordingly an examination of the Stage B PER and Cloud Break PER in unison would not allow the proper assessment of the cumulative environmental impact of the Cloud Break and Christmas Creek Projects. (Submission 3)***

The Stage B PER did not include an assessment of the cumulative effects of the Cloud Break and Stage B proposal, as Cloud Break was not discovered as an economic resource for development at the time of publication. However, when preparing the EIA for the Cloud Break proposal, FMG did include an assessment of the cumulative impacts of Stage B (in its present form) and Cloud Break (Section 6.14). To supplement this information, Appendix B of this report provides an update of FMG's projects and how they interact.

## 7.3 SITE ENVIRONMENTAL MANAGEMENT

**7.3.1** ***The FMG Cloud Break PER does not include any assessment of potential environmental impacts associated with the construction and operation of the haul road (for the transportation of ore rather than the rail). Nor does it include the likely alignment of such a haul road. Potential impacts associated with traffic, noise, dust, fauna and surface water drainage would be expected to be relevant to such a haul road. This therefore creates uncertainty and confusion regarding:***

- ***The relevance of the impact assessment included within the FMG Cloud Break PER; and***
- ***The basis for any cumulative impact assessment required for other projects within the region. (Submission 6)***

As stated in Section 5.3.3 of the Cloud Break PER, ore from the Cloud Break Project will be transported to Port Hedland by rail. Low grade material requiring beneficiation at the Stage B beneficiation plant will be initially stockpiled and then transported by rail to the beneficiation plant at Christmas Creek after Year 7. Proposed haul roads required to link the mine to the crushing plant and rail loadout within the Cloud Break Project Area are shown as the 'Transport Corridor' in Figure 2 of the PER. The cumulative impacts of FMG's projects have been assessed on the basis of these assumptions (refer to Section 6.14 of the PER).

If, at a later stage, FMG decided to construct a haul road rather than a railway, either temporarily or permanently, then it is expected that this would require a further submission under the *Environmental Protection Act (1986)*.

**7.3.2** ***Page XXV many of the management measures on previous pages are expressed as things that 'will' be done, why are those on this page things that only 'may' be done? (Submission 8)***

FMG has committed to carrying out the items listed on page XXV and they are not seen as optional. On page 86 FMG states:

"Specific management measures for threatened species include:

- creating 'no-go' zones in the areas where samphire meets Spinifex, with driving curfews in sensitive areas at night and dusk to reduce the risk of road kills of significant fauna such as Night Parrot;
- minimising night driving in potential habitat for the Pilbara Olive Python;
- monitoring existing Bilby and Pebble Mound Mouse populations within or near the Project Area;
- surveying any sandy or sandy-loam habitats that support Spinifex that are likely to be developed

within the Project Area, and may support Mulgara or Bilby;

- undertaking further research into the biology and ecology of the Night Parrot; and
- implementing the management plans developed for significant species."

### 7.3.3 *Will a weather station be created at the proposed mine site? (Submission 8)*

A basic weather station is currently in the process of being installed at the Cloud Break camp. FMG already monitor rainfall at a number of locations across its tenements. Once mining commences there will be the need for a more sophisticated monitoring unit for aircraft using the airstrip, and the current station would be upgraded at this time.

## 7.4 OFFSETS

### 7.4.1 *Although we oppose the Project as currently contemplated, it is clear it could be made more palatable if the proponent was to fund the early acquisition of the Project area and surrounding 2015 excision areas from the relevant pastoral owners and then the transfer (of the surrounding areas at least) into the conservation estate. (Submission 8)*

FMG has consulted with CALM and other key stakeholders in the formulation of the offsets package outlined in section 3. Following discussions with CALM, FMG has agreed contribute $1,000,000 towards a fund directed at land acquisition.

### 7.4.2 *We oppose any further reductions in the 2015 excisions for this region – they have already been compromised enough by negotiation with the pastoral non-owners. We strongly support those excised areas then going on the become part of the conservation estate as soon as possible. (Submission 8)*

Refer to response 7.4.1.

As part of its offset package (refer to Section 3), FMG has agreed to contribute $1,000,000 to a fund to enable CALM to acquire areas of the proposed 2105 conservation reserve areas early. The final boundaries of the conservation reserve cannot be determined until the DPI consultation process is undertaken in 2015 after the pastoral leases revert to crown land.

### 7.4.3 *The proponent has not discussed or committed to an appropriate offset package which contributes to environmental management measures to counterbalance an adverse environmental impact or harm. (Submission 10)*

FMG would disagree that no consultation has been carried out regarding offsets. FMG and CALM have been in discussions for sometime in order to negotiate an appropriate offset package for both parties for Stage B and Cloud Break. The package outlined in Section 3 is very close to a final package agreeable to both FMG and CALM based on discussions undertaken to date.

**7.4.4** ***The proponent should consider submitting a detailed offset package which includes resource and financial commitments that properly address the residual impacts of this proposal and the high significance of the values present. Notwithstanding CALM's overall position in relation to this proposal, the Department will continue to negotiate with the proponent to develop a suitable package that is consistent with the purpose and objective of offsets as defined by the EPA. (Submission 10)***

The proposed offset package for Cloud Break is discussed in Section 3.

## 7.5 INTERACTION WITH STAGE B PROJECT COMPONENTS

**7.5.1** ***Concerns over the selection of the railway route, particularly through the Chichester Ranges, as there will be a significant impact on linear sheet flow and that there is a preference that the transport corridor be on the other side of the range. (Submission 2)***

The assessment for FMG's rail alignment has been undertaken as part of the Stage B PER. The selection of the route was undertaken to minimise cumulative environmental impacts in the long term and to provide the best possible access to all resources. Following comments on the Stage B PER, the Stage B railway has been realigned to further reduce the potential impacts on mulga and sheet flow (refer to Appendix A). Managing the effects on sheet flow, and other environmental concerns relating to the railway, are dealt with in the Stage B assessment and commitments (EPA, 2005).

**7.5.2** ***The present Cloud Break environmental review process is flawed because:***

- ***the Cloud Break PER does not address all material aspects of the proposal, notably the re-aligned railway from Cloud Break to the Port Hedland railway;***
- ***the Cloud Break PER purports to rely on various aspects of the Pilbara Iron Ore and Infrastructure Project: E-W Railway and Mines Site Stage B public environmental review ("Stage B PER") notwithstanding the significant changes to the Stage B Project announced since the public review process;***
- ***the Cloud Break PER is inconsistent with aspects of the Stage B PER; and***
- ***the Cloud Break PER does not address the cumulative effect of the current Cloud Break and Christmas Creek Projects. (Submission 3)***

Changes have been made to the Stage B Project since the release of the Stage B PER, including realignment of the rail to the west of Cloud Break. These changes, which are summarised in Appendix B, are not considered significant and in many cases reduce the potential environmental impact of Stage B. The changes made to the Stage B proposal were incorporated into the response to Submissions for the Stage B Project and the EPA prepared Bulletin 1202 based on the revised Project.

The Cloud Break PER considers the cumulative impacts of FMG's projects (see Section 6.14 of the PER) including the changes to the Stage B Project. The proposed new rail alignment was included as Figure 1 in the PER.

**7.5.3** ***The EPA should require FMG to submit a consolidated Cloud Break – Christmas Creek proposal for further public review that:***

- ***resolves the conflict between the three PERs submitted by FMG;***
- ***addresses all aspects of the consolidated proposal, including those identified below as omitted from the current PERs; and***
- ***accurately quantifies the cumulative impacts of the consolidated proposal. (Submission 3)***

Appendix B summarises the changes to FMG's Stage A and B Projects and how these relate to the Cloud Break Project. Section 6.14 of the Cloud Break PER addresses the potential cumulative impacts of FMG's projects, and already takes into consideration changes to the Stage B proposal.

FMG believes it is not necessary for a consolidated Cloud Break – Christmas Creek proposal to be submitted for further public review because the changes made to the Stage B proposal are minor and are incorporated into the response to Submissions for Stage B. The EPA prepared Bulletin 1202 based on the revised Project.

**7.5.4** ***In addition to the Cloud Break PER, a further proposal described as "Cloud Break Iron Ore Mine – E46/590, E45/2498 and E45/2499" was referred to the EPA by FMG during April 2005 and was set a "public environmental review" level of assessment of 9 May 2005. The submitter understands that this proposal covers the same mining operations as the Cloud Break PER although it also includes the construction of a beneficiation plant at Cloud Break. It is not apparent whether FMG intends to proceed with this second Cloud Break referral and how it may interact with the Cloud Break PER or Stage B PER. (Submission 3)***

The Cloud Break Iron Ore Mine (with beneficiation) was initially referred to the EPA on May 9 2005 and was set a Public Environmental Review level of assessment. This was subsequently withdrawn from the assessment process and replaced with the Cloud Break (No Beneficiation) proposal. It was made clear within the Cloud Break PER released for public comment that the proposal did not include beneficiation.

**7.5.5** ***Concern over the impact that the Cloud Break and Stage B Projects will have on the development of the submitters Roy Hill mining tenements ("Roy Hill Project") adjacent to Christmas Creek…The EPA has advised the submitter that for the purpose of the Roy Hill environmental assessment, it should not take account of the railway across the Roy Hill project east of Christmas Creek as proposed in the Stage B PER because FMG has abandoned that part of the proposal. However, HPPL is required to take account of the cumulative effect of the remainder of the Stage B PER. Given FMG's increasing emphasis on Cloud Break, the changes to the Christmas Creek proposal and the concerns about the Cloud Break PER and the Stage B PER the submitter does not consider that FMG's current proposal is adequately explained. (Submission 3)***

A summary of Project changes is included as Appendix B of this document. The new rail alignment can be seen as Figure 1 of the Cloud Break PER. FMG believes that by reviewing the Cloud Break PER, the Stage B PER, the Stage B Response to Submissions, and this document, that the EPA has sufficient information to assess cumulative impacts.

**7.5.6** ***Under the Cloud Break PER, lower grade ore mined from Cloud Break will be transported to Christmas Creek for beneficiation which will result in an increase in the operation, and therefore environmental impact of the beneficiation plant. This is not assessed in either the Cloud Break or Stage B PER. However, the Christmas Creek beneficiation plant water requirements, pit dewatering, groundwater recharge and surface water management may affect the Roy Hill Project's environmental impact assessment and project development. (Submission 3)***

The Stage B Project has been revised so that mining at Mt Nicholas and Mt Lewin is no longer proposed. The changes to the Project are outlined in Appendix B. It is proposed that the ore will be provided from Christmas Creek and Cloud Break mines, rather than from Mt Nicholas, Mt Lewin and Christmas Creek mines as originally proposed. There will be no increase in the operation, as the total tonnage of ore requiring beneficiation will remain the same as proposed for the Stage B Project, resulting in similar water requirements.

Also refer to 7.5.8.

**7.5.7** ***None of the recent changes to the Stage B Project, all of which were announced after the completion of the public review period for the Stage B PER, have been addressed by the Cloud Break PER. (Submission 3)***

Appendix B summarises the changes to FMG's Stage A and B Projects and how these relate to the Cloud Break Project. The changes to the Stage B Project have resulted in a reduction of the area of disturbance and the introduction of the Cloud Break proposal does not increase the cumulative impact of Stage B and Cloud Break proposal such that it is greater than the original Stage B proposal. Section 6.14 of the Cloud Break PER further discusses the potential cumulative impacts of FMG's projects taking into consideration these changes.

Changes to the Stage B Project were incorporated into the Response to Submissions document which was reviewed by the EPA in the preparation of their recommendations to the Minister for the Environment. This document recently closed for its two week statutory public comment period.

**7.5.8** ***The Cloud Break PER relies on the beneficiation of lower grade material mined from Cloud Break at the proposed Christmas Creek beneficiation plant which is the subject of the Stage B PER. The Cloud Break PER expressly states that the environmental impacts of the plant have not been assessed as part of the Cloud Break PER because of its inclusion in the Stage B PER. (Submission 3)***

Appendix B summarises the interaction between the Cloud Break, Stage B and Stage A proposals. The volume of ore that will require beneficiation from Cloud Break, based on current mining information, is 425 Mt. The volumes of ore requiring beneficiation from Mt Lewin and Mt Nicholas was to be approximately 590 Mt and it was on this value that water requirements for the beneficiation plant were identified. FMG considers that the information provided in the Stage B PER on the beneficiation plant is still current, although the assessment of the potential impacts of beneficiation are likely to represent an overestimate due to the subsequent reduction of ore requiring beneficiation and the ability to supplement the water requirements for the beneficiation plant from pit dewatering at Cloud Break.

**7.5.9** ***In addition, it appears from an announcement made by FMG on 14 June 2005 that the Stage B proposal will be changed to provide a heavy haul road rather than a railway between Christmas Creek and Cloud Break, However, the haul road is not addressed in either the Cloud Break PER or Stage B PER. This highlights the inherent problems with FMG's changing proposals and the separate assessment processes. (Submission 3)***

FMG plans to construct a haul road in the rail corridor between Christmas Creek and Cloud Break for transport between the mines until the rail can be constructed. Advice will be sought from the EPA regarding the approvals required.

Also see 7.3.1.

**7.5.10** ***Further, while claiming that "the water for the beneficiation will also be provided as part of the Stage B PER", the Cloud Break PER also states that excess water from dewatering at Cloud Break will be transported to Christmas Creek for use in the beneficiation plant. The statements are inconsistent and compromise any proper assessment of the water use and management of both PERs. As noted above, the Christmas Creek beneficiation plant water requirements, pit dewatering, groundwater recharges and surface water management may affect water drawdowns in relation to the Roy Hill Project and other developments in the region. (Submission 3)***

Dewatering from Cloud Break will be used to supplement the water required for beneficiation from the Stage B borefield. Therefore less water will be required to be abstracted from the water supply borefield, reducing the potential impacts that were outlined in the Stage B PER. The potential impacts of pit dewatering at Christmas Creek are not expected to change and were discussed in the Stage B PER, and the potential impacts of pit dewatering at Cloud Break are discussed in the Cloud Break PER.

**7.5.11** ***The Cloud Break PER notes at 5.3.1.2 that, based on FMG's current mining schedule, the beneficiation plant at Christmas Creek (expressly stated not to be part of the Cloud Break PER assessment) will be constructed during year 7. This is inconsistent with the Stage B PER which provided that the beneficiation plant at Christmas Creek would be constructed at the commencement of mining at Christmas Creek and would be later relocated to the Mt Nicholas prospect. (Submission 3)***

The definition of suitable volumes of direct ship ore at both Christmas Creek and Cloud Break have enabled a delay in the construction and need for the beneficiation plant at Christmas Creek until Year 7. This is a positive environmental outcome. The decision to maintain the beneficiation plant at Christmas Creek is because Mt Nicholas is no longer a part of the mining schedule and therefore will not require the construction of a beneficiation plant.

**7.5.12** ***In addition, the Cloud Break PER refers to some aspects of the Cloud Break proposal as forming part of the Stage B PER, such as power and water requirements. In order to accommodate the additional Cloud Break requirements, the Stage B proposal as submitted for public review by way of the Stage B PER must have been substantially changed. However, there is no way of determining in what way the Stage B proposal has been changed and the consequential environmental impact. More importantly, the public, including HPPL, have not been given an opportunity to review those changes. (Submission 3)***

Refer to Appendix B for a summary of the changes to the FMG projects. FMG believes that the changes to the Stage B PER are not significant and was advised by the DoE to incorporate them into the preparation of the Response to Submissions document.

The Cloud Break PER states that the water required for the Cloud Break Project will be mainly from dewatering activities associated with mining. As with the Stage B assessment, power will be provided and maintained by a third party supplier who will be required to meet all statutory approvals.

**7.5.13** ***It appears from the Cloud Break PER that a new railway alignment is proposed between Cloud Break and the Port Hedland railway. However, the Cloud Break PER fails to address this railway alignment. (Submission 3)***

The railway alignment proposed in Stage A remains the same, apart from a reduction in length. The east-west railway from the Chichester Ranges to Christmas Creek proposed as part of Stage B has been realigned and reduced in length, as discussed in Appendix B. The specific details of this railway have been addressed as part of the Stage B assessment (EPA, 2005).

**7.5.14** ***Although the proposal to transport ore from Christmas Creek to the Port Hedland by rail was included in the Stage B PER, the transport of ore from Cloud Break to Christmas Creek for beneficiation and the environmental impacts from the additional loading/unloading and traffic were not addressed; those environmental impacts have not been considered in the Cloud Break PER. (Submission 3)***

The total volume of ore that will be handled at the Christmas Creek beneficiation plant has not increased as a result of removing the Mt Lewin and Mt Nicholas mines and with the addition of the Cloud Break mine. The overall volume of ore to be mined between the Christmas Creek, Mindy Mindy and Cloud Break mines is still 45 Mtpa. It is the belief of FMG, based on current mining scheduling, that the environmental impacts of transport will not change as a result of the project changes to Stage B and the addition of Cloud Break. For further information on the project changes refer to Appendix B.

**7.5.15** ***Three potential mining methods and related crushing and screening facilities required to process ore for railing are referred to, but not detailed or quantified in the Cloud Break PER. (Submission 3)***

FMG is currently undergoing a detailed feasibility study and until this is finished, detail on the preferred method of mining will not be decided. FMG has therefore presented a number of possible scenarios for mining. The level of detail provided in the PER is consistent with similar proposals in Pilbara.

**7.5.16** ***The truck unloading facilities, heavy haul road and truck traffic for approximately 20 Mtpa of high grade ore from Christmas Creek are not detailed or quantified in the Cloud Break PER. (Submission 3)***

Transport of ore from Christmas Creek is part of the Stage B assessment.

Refer also to 7.5.14.

**7.5.17** ***The rail connection and train loading facilities necessary to enable high grade ore to be transported from Cloud Break to Port Hedland have not been considered in the Cloud Break PER. (Submission 3)***

Figure 11 of the Cloud Break PER shows the proposed rail corridor where facilities will be constructed. Section 5.3.3 discusses FMG's methodology for transport from the mine to the Port, and Table 4 discusses the overall disturbance area of the Cloud Break mine. The specific information relating to the location of the rail load out, and the rail corridor itself, will be determined later in the mine planning process. However, FMG believes the information presented is sufficient to assess the environmental impact of all aspects of the Cloud Break Mine, including train load out.

**7.5.18** ***The Cloud Break PER does not provide a fully informed and accurate assessment of the Project and its likely impact on the environment, either as a separate project or as an integrated project with Christmas Creek. (Submission 3)***

The Cloud Break PER contains the results of a range of environmental studies and undertakes to conduct further studies as the Project proceeds. FMG has already committed to a range of environmental management measures and expects the EPA to have sufficient information complete an assessment and make a recommendation to the Minister for the Environment. Project changes to Stages A and B and their interaction with Cloud Break are outlined in Appendix B. Section 6.14 of the Cloud Break PER assesses the cumulative impacts of the Project with FMG's other proposals.

**7.5.19** ***Our examination of the Cloud Break PER and FMG's Stage B PER has revealed significant inconsistencies in the description of the FMG's proposed activities in the Cloud Break/Christmas Creek area. (Submission 6)***

On 8 July 2005 the EPA were advised of some changes FMG had made to the Stage B Project, which arose as a result of the discovery of the Cloud Break Project, and a review of the financial and environmental components of the Project. Notably these changes are:

- removal of the Mt Lewin and Mt Nicholas mines from the mining schedule;
- removal of the railway corridor east of Christmas Creek; and
- realignment of the railway corridor west of Cloud Break to a more northern alignment.

The above changes will result in fewer environmental impacts than the original Stage B proposal, including reduced area of clearing, reduced impact on Mulga, and selection of a rail alignment closer to that preferred by CALM.

Any comparison with the Stage B Project that is made in the Cloud Break PER refers to this revised Stage B Project. Detailed project changes are outlined in Appendix B.

**7.5.20** ***Neither PER addresses the cumulative affect of the current Cloud Break Project, and secondly the lack of a clearly defined FMG Project affects HPPL's ability to assess the potential cumulative impacts of its own proposed activities at Roy Hill. (Submission 6)***

Cumulative impacts of the Cloud Break Project, the amended Stage B Project, and the Stage A Project are discussed in Section 6.14 of the Cloud Break PER. Appendix B of this Response to Submissions provides a summary of FMG's projects including the revised Stage B Project and the interactions with the Cloud Break Project. This submitter is welcome to contact FMG to clarify any part of its projects which are unclear.

**7.5.21** ***FMG's Cloud Break PER states that the Stage B Project would not include operation of the Mt Lewin or Mt Nicholas mines, which are located east of Christmas Creek. However, the FMG Stage B Project PER clearly describes Mt Lewin and Mt Nicholas as being part of the Stage B Project. (Submission 6)***

The Stage B proposal no longer includes mine sites at Mt Lewin and Mt Nicholas. Refer to Appendix B of this Response to Submission for a summary of FMG's project including the revised Stage B Project.

**7.5.22** ***It remains unclear which parts of FMG's proposed activities are current and what cumulative effects the proposed projects would have. (Submission 6)***

Discussion of cumulative impacts in Section 6.14 of the Cloud Break PER takes into consideration the amended Stage B Project. Refer to of this Response to Submission for a summary of FMG's proposals including the revised Stage B Project.

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**8.**

**9. SUMMARY TABLE OF SUBMISSIONS**

**MATRIX IDENTIFYING ISSUES RAISED BY GENERAL PUBLIC AND CONSERVATION GROUPS TENDERING SUBMISSIONS TO DEVELOPMENT PROPOSAL**

**NOTE: ISSUES NOT TO BE IDENTIFIED WITH NAMES OF SUBMITTERS**

**= PRO DEVELOPMENT**
**= ANTI DEVELOPMENT**
**= NEUTRAL**

| SECTION | ISSUES | SUBMISSION NUMBER | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **BIOPHYSICAL** | | | | | | | | | | | |
| 4.1 | Conservation Areas | | | | X | | | | X | | X |
| 4.2 | Fortescue Marsh | | | | X | | | X | X | X | X |
| 4.3 | Surface Water | | X | X | X | | | X | X | X | X |
| 4.3 | Rainfall/ Flood Events | | X | | | | | X | | | |
| 4.4 | Sheet flow and Mulga Woodlands | | X | | | | | X | X | | X |
| 4.5 | Groundwater | | X | X | X | | X | X | X | X | X |
| 4.6 | Flora and Vegetation | | X | | X | | X | X | X | | X |
| 4.7 | Weed Management | | | | | | | | | | X |
| 4.8 | Terrestrial Fauna | X | X | | | | | | X | | X |
| 4.9 | Night Parrot | X | X | | | | | | X | | X |
| 4.10 | Stygofauna | | X | | | | | | X | | X |
| 4.8.10 | Aquatic Fauna | | | | | | | | | | X |
| 4.11 | Rehabilitation and Closure | X | X | | X | | | | X | | X |
| **POLLUTION** | | | | | | | | | | | |
| 5.1 | Air - Dust | | X | | | | X | | X | | X |

| SECTION | ISSUES | SUBMISSION NUMBER | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 5.2 | Air – Greenhouse Gas | | X | | | | X | | X | | X |
| 5.3 | Noise and Blasting | | | | | | X | | X | | X |
| 5.4 | Acid Mine Drainage | | X | | | | | | X | | |
| **SOCIAL** | | | | | | | | | | | |
| 6.1 | Stakeholder Consultation | | | | | X | | | | | |
| 6.2 | Impacts on Pastoral Activities | | | | | X | | | | | |
| **OTHER** | | | | | | | | | | | |
| 4.11.3, 5.7 | Mining and Processing | | X | X | | | X | | | | |
| 7.3.1, 7.5.1, 7.5.14, 7.5.17 | Transportation of Ore | | X | X | | | X | | | | |
| 7.1 | Assessment under the EP Act (86) | | | | X | | | X | | X | X |
| 4.8.1 | Consistency with EPA Guidelines | X | | | | | | | | | |
| 4.3.12, 4.8.23, 4.8.26, 4.11.7, 4.11.9, 4.11.10, 6.1.13, 7.1.3 | Proponent Commitments | | | | | X | | X | X | | X |
| 7.3 | Site Environmental Management | | | | X | | | | X | | |
| 3, 7.4 | Offsets | | | | | | | | | | X |
| 7.5 | Interaction with Stage B Project | | | X | | X | | | | | |
| 4.6, 4.8, 4.9, 5.1-5.3, 7.2, 7.3.1, 7.5.2, 7.5.20, 7.5.22 | Cumulative Impacts | X | | X | X | X | X | | X | | |
| 4.2.11, 4.8.19 | Legitimacy of Studies (Peer Review) | X | | | | | | | X | | |

## 10. REFERENCES

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# FIGURES

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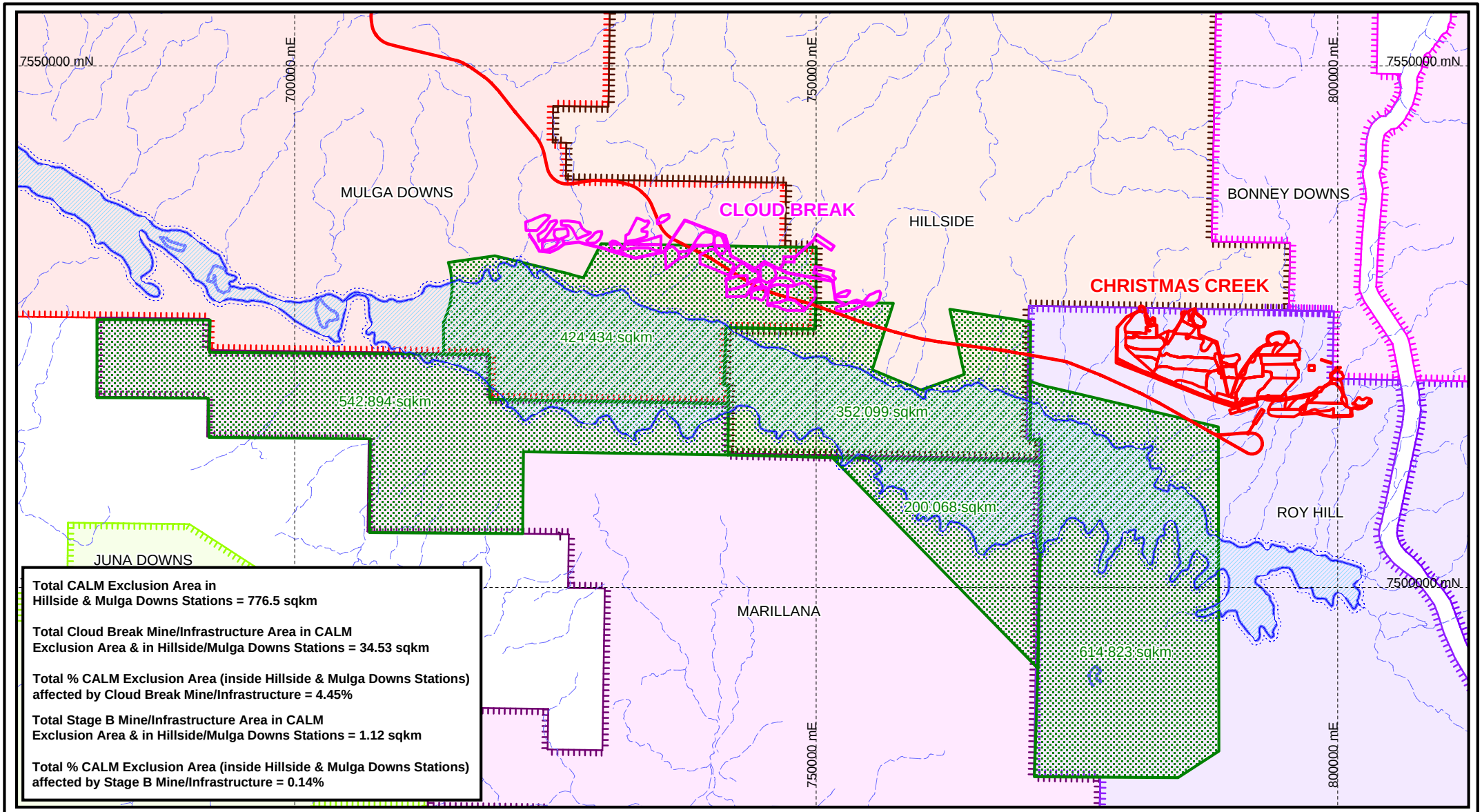


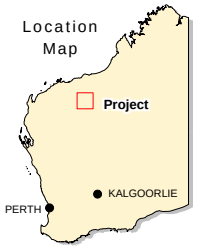

**Total CALM Exclusion Area in Hillside & Mulga Downs Stations = 776.5 sqkm**

**Total Cloud Break Mine/Infrastructure Area in CALM Exclusion Area & in Hillside/Mulga Downs Stations = 34.53 sqkm**

**Total % CALM Exclusion Area (inside Hillside & Mulga Downs Stations) affected by Cloud Break Mine/Infrastructure = 4.45%**

**Total Stage B Mine/Infrastructure Area in CALM Exclusion Area & in Hillside/Mulga Downs Stations = 1.12 sqkm**

**Total % CALM Exclusion Area (inside Hillside & Mulga Downs Stations) affected by Stage B Mine/Infrastructure = 0.14%**




- Cloud Break Mine & Infrastructure
- Stage B - Christmas Creek Mine & Infrastructure
- CALM Exclusion Area
- Pastoral Lease Boundaries

N

0 5 10
kilometres

**Fortescue Metals Group Limited**

**Figure 1: Cloud Break & Christmas Creek Projects with CALM Exclusion Areas & Pastorall Lease Boundaries**

| | |
|---|---|
| Author: D Dowdell | Date: 02 Nov 05 |
| Drawn By: G Matthews | Revised: 10 Nov 05 |
| Plan No.: 05_195_1110_ENV | Report No.: |
| Projection: MGA50 | Scale: 1:500,000 |

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# Appendix A

# Re-establishing Sheet Flow - Report on field trials for water redistribution conducted at Woodie Woodie

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# Re-establishing Sheet Flow

Report on field trials for water redistribution conducted at Woodie Woodie

25-29 May 2005

C Muller Consulting
**ABN 63 195 874 227**

cmconsult@gmail.com
Mobile 0418938223

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cmconsult@gmail.com
Mobile 0418938223

# Summary

## Introduction

Fortescue metals Group Pty Ltd (FMG) are proposing to construct a railway line to link mine sites in the central Pilbara with the port at Port Hedland. A portion of this proposed railway line passes both through and upslope of mulga stands of high conservation significance in the vicinity of the Fortescue Marsh. The distribution of the mulga is dependant, in part, on sheet flow. Construction of a railway will interrupt such flow, and concentrate flow through culverts. To reduce impacts, it has been proposed that numerous 300mm diameter culverts be included in the embankment to provide environmental flows, however there will still be a significant area of potential drainage shadow until the water spreads, and sheet flow is re-established. (Muller 2004). To minimise such impacts, engineering structures are proposed to respread the water close to the point discharge.

Preliminary trials to investigate spreader ditches and rock levees (Muller 2004) identified some difficulties with spreader ditches, and demonstrated that permeable levee banks showed potential to be utilised to redistribute water cheaply and effectively. The report on those preliminary studies recommended:

> "that FMG consider the following further work:
>
> - Conduct trials with a range of graded crushed rock material from likely sources to determine optimum material for levee bank construction to provide the balance between spread and permeability. Such trials should include:
>   - heavy sediment loads to provide accelerated siltation so as to investigate long term performance
>   - varying widths of levee to determine the maximum width that will provide the desired permeability
>   - assessment of the resistance to cattle damage
>
> - Investigate the susceptibility to erosion/damage of the spreader levees under full discharge plus head for the design return period event for the railway line, and determine if gabions or similar are required at discharge points.
>
> - Investigate the maximum effective length of spreader levee for a range of rainfall events, from the minimum that is expected to result in overland flow, to the maximum design criteria discharge event. This will assist in design of effective culvert spacing in areas where sheet flow is to be re-established."

These recommendations formed the basis for the trials the subject of this report. In addition, the opportunity was taken to test a reviewed design of the spreader ditch, which aimed to reduce susceptibility to slumping and cattle damage.


cmconsult@gmail.com
Mobile 0418938223

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cmconsult@gmail.com
Mobile 0418938223

# Trial Investigations

# 1 Levee Parameters

## *1.1 Objective:*

To determine effect of rock size and levee bank width on the rate at which water passes through the barrier

The extent to which the water is to be spread will determine the required permeability of a levee barrier. Theoretical calculation of the permeability is complex, with variables including void size, void percentage, levee dimensions, void shape, and water velocity. The aim of the trial is to investigate empirical relationships that will provide a guide to optimum rock size and levee dimensions to provide desired distribution for environmental flows.

## *1.2 Method*

The site for the levees was surveyed and levels pegged. Due to the limitations of the site and distance from water supply, the "wide" bay in each case was not level (see Appendix 1).

Three levees were constructed on the pegged lines from 35-75mm, 75-120mm and 120-180mm screened rock respectively. Each levee was divided into four 10m sections divided by earth mounds (as per figure 1). Different width levee walls were constructed for each of the four sections for each levee. It was intended that the widths be nominally 250mm (or as narrow as practicable), 500mm, 1000mm, and 1500mm wide in the three bays. Levees were constructed by tipping the rock from a loader bucket (Picture 1), and in practice, the two narrower wall widths were 4-500mm and 700mm respectively. For the purposes of this trial the levees were trimmed by hand to a uniform width.

**Picture 1: Constructing trial levees**

The height of the levees was approximately 2-300mm.



cmconsult@gmail.com
Mobile 0418938223

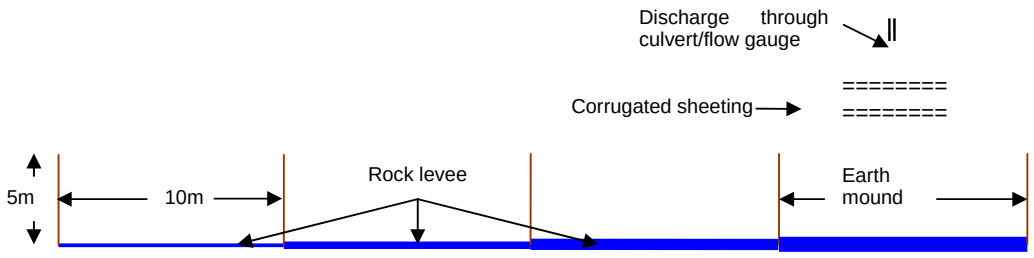


**Figure 1: Schematic of trial layout.**

Water was pumped through 276m of 8" layflat hose and 22m of dual 6" layflat hose to a T coupling fitted with gate valves. Flow to the trial was controlled by varying the valve settings on the (6") line to the trial discharge, and an 8" diversion discharge.

Due to a delay in the arrival of the flow meter, flow rates for the initial series of trials were calculated for a range of valve settings from the time taken to fill a 200 litre drum (Picture 2). Subsequently direct flow measurements were taken with a flow meter (Picture 3) on a section of 140mm ID poly pipe. All flow readings were taken on this section of poly pipe as the meter could not be utilised on the layflat hose.

Corrugated sheeting was used at the discharge point to minimise scouring.

**Picture 2: Determining flow rate for various valve settings**

**Picture 3: Direct flow measurement with flow meter**

Water was discharged into individual bays at varying rates, generally between 4 litres/second and 10 litres/second in each 10m (nominal) bay. A limited number of trials were conducted with much higher discharges (up to 26 litres/second). Each flow


cmconsult@gmail.com
Mobile 0418938223

rate was maintained for a sufficient period for the flow to stabilise (ie discharge into the bay equals flow through the levee wall), and the depth of water at the levee recorded. Where the bay was not level ("wide" bays) both the maximum and minimum depths were recorded.

The effective length through which discharge occurred was recorded for each levee.

Two series of trials with varying flow rates were conducted for each bay.

The "packing ratio" of the different size screened rock material used in constructing the levees was determined by filling a 200 litre drum with the rock, measuring the amount of water required to fill the drum, and from this calculating the percentage void. This was repeated three times for each rock category.

## *1.3 Results*

The length of the levee in the bays varied slightly due to the method of construction.

In three small sections of levees "fines" were included during construction, as a result of the loader scraping together the rock pile during loading. These sections effectively acted as a dam wall, as there was no discharge through them (Picture 4). One of these

**Picture 4: Fines mixed with screened rock prevent flow.**

sections was at the high end of the 1.5m wide large rock levee. The consequent reduction in effective length also reduced the slope (see appendix 1) of the remaining section of levee.

To allow for these variations, all. results are expressed in terms of “effective length”. i.e. that length of levee through which water percolated.

The results of the trials are summarized in the following graphs, with more detailed regression analyses in Appendix 2.

In each case, the graph on the left incorporates all the results from the trials on the individual bays, and those on the right are restricted to flows per metre of levee less than 1.5 litres/second. Most of the higher flow events appear as apparent outliers in the data set..

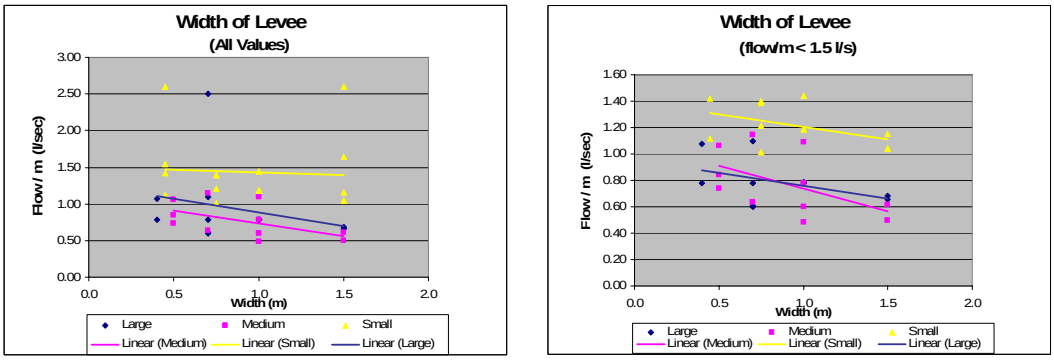


**Figure 2: Effect of levee width on flow**

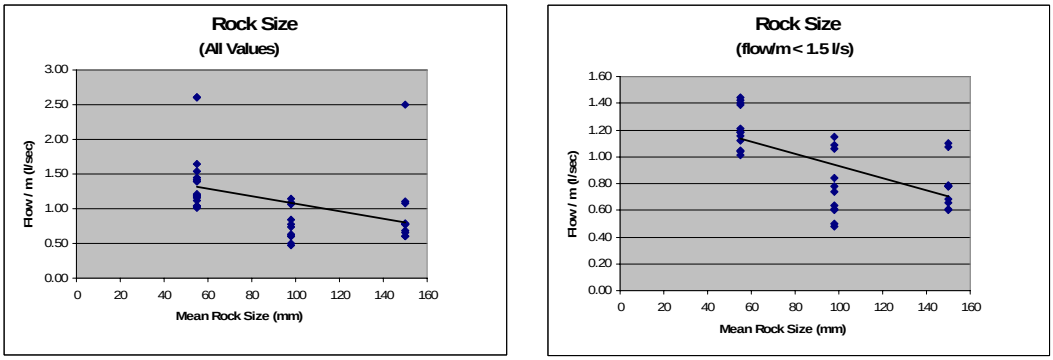


**Figure 3: Effect of rock size on flow (data points for all widths of levees shown)**



cmconsult@gmail.com
Mobile 0418938223

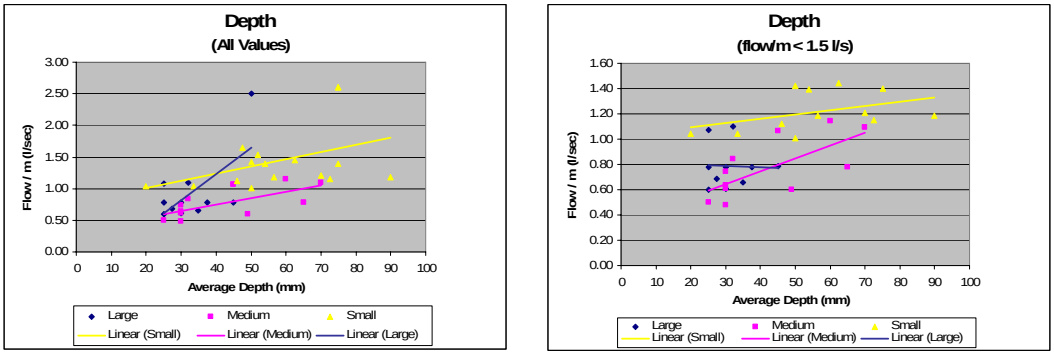


**Figure 4: Effect of depth of water at levee wall**

Trend lines have been shown on the above graphs, but these must be treated with caution. Reasonable correlations were observed for most cases for flows per metre of levee of less than 1.5 litres/second (see appendix 2), but not if higher flow rates were included. In all cases the trends were similar for the medium and small rock material, but less consistent with the large rock material, particularly for the narrower levee widths. The regression analysis shows no apparent correlation between levee width and flow for the large material.

The trials to determine packing ratio/void % were also much more variable for the large rock than for the other two screened sizes (Table 1)

| Trial | Large | Medium | Small | Main Levee |
|---|---|---|---|---|
| | Void space (litres) | | | |
| 3 | 102.9 | 93.6 | 97.1 | 92.9 |
| 2 | 100.0 | 95.7 | 101.4 | 92.9 |
| 1 | 92.9 | 98.1 | 105.7 | 87.1 |
| Mean | 98.6 | 95.8 | 101.4 | 91.0 |
| | Void space (percentage) | | | |
| 3 | 51.5% | 46.8% | 48.6% | 46.5% |
| 2 | 50.0% | 47.9% | 50.7% | 46.5% |
| 1 | 46.5% | 49.1% | 52.9% | 43.6% |
| Mean | 49.3% | 47.9% | 50.7% | 45.5% |

**Table 1: Void space related to screened rock size**

The combined effects of levee width, rock size and water depth are presented in Appendix 2 as a multiple linear regression for these parameters vs flow/metre (App 2 S 3.1), and as a simple linear regression between a combined value (void area/width) and total flow assuming :

total flow = f (total area of levee involved, width of the levee, void space in levee).

A summary graph of this combined value vs flow showing the contribution of each rock size is shown in figure 5.

The “void area” in figure 5 and in the regression in Appendix 2 (S 3.2) is the surface area of the portion of levee involved (from effective length and depth measurements) times the percentage of piled rock that is void.

The correlation between total flow and the value of void area/width is strongest for the medium size rock, but still a reasonably strong correlation for the other sizes for total flows less than that equivalent to flow/m < 1.5 litres/second.

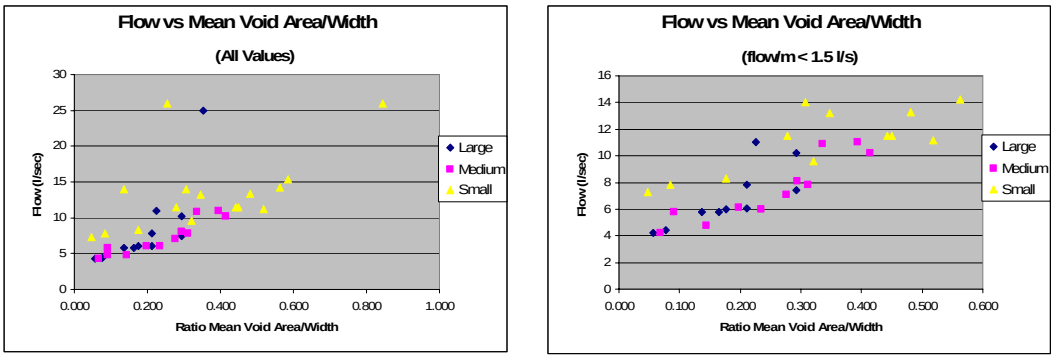


**Figure 5: Relationship between total flow and "Void Area"/levee width, where "Void Area" = (surface area of levee involved) * (void%)**

## *1.4 Discussion*

The primary interest was to determine parameters for spreading flows from environmental culverts for a width of around 100 metres (the environmental culvert spacing suggested by Aquaterra). The environmental culverts have a design flow of up to 67 litres/sec (V Piper, Aquaterra). The trials therefore concentrated on flow rates between 4 and 10 litres/sec so as to test permeability in the range of 0.5-1 litre/sec/metre, however the opportunity was also taken to observe the performance of the levees at higher flow rates.

The most consistent results were obtained with the medium size rock, and the least consistent with the large rock. It is postulated that the variable results with the larger material are a result of less uniformity due to the fewer (although larger) voids between rocks. Fewer but larger spaces results in much greater “stepped” changes (i.e. either a large void or nothing for water to pass through, rather than more uniformly distributed smaller voids), accounting for some of the large variation in results with the limited range and number of samples in this trial. This variability is most



cmconsult@gmail.com
Mobile 0418938223

noticeable with changes in depth (figure 4), where a small increase can result in a new large pathway becoming available for the water to flow through.

The use of large rock for distribution of low flows is not recommended, both because the high variability increases the risk of failure, and because of difficulties associated with constructing uniform levees with this material, particularly levees narrower than 1 metre.

The flow rates through the small rock were too great to predict a spread of 100m within the range of levee widths in this trial. The strong trend shown for reduced flow with increased levee width would suggest that effective distribution could be achieved with wider levees, however, despite the strong correlation shown, the results should not be extended beyond the range of the trial data. Increasing the width would, in any case, require more material and increase the cost of constructing levees.

Rock in the medium size range is the most suitable, and the levee widths in this trial provided a suitable range of permeability to spread the environmental flows.

The rapid increase in flow through the levee with increased depth has two important implications:

- The ability to cope with a higher range of flows. A levee designed to spread low flows can also re-distribute much higher flows. As the depth of water increases, so does the permeability of the levee, effectively resulting in a self adjusting system to spread flow.
- The increase in permeability with depth of water restricts the size of the undulations over which water can be effectively spread at low flow rates; i.e. as depth increases more water will pass through the levee rather than be spread. The proportion of flow that will pass any obstacle/undulation and the maximum height of any rise over which water can be spread for any particular flow can be estimated from Figure 4 or preferably, for a medium rock levee.0.7 to 1m wide, from Appendix 2, S 4.1.

The accidental inclusion of “fines” in portions of the levee walls during construction rendered these section non-permeable. For predictable performance it is essential that screened rock be used, and care taken to minimise contamination of this material during constructing the levees.


cmconsult@gmail.com
Mobile 0418938223

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cmconsult@gmail.com
Mobile 0418938223

# 2 Full Scale Spreader Trials

## *2.1 Objective*

Evaluate the effectiveness of full scale spreader structures (both levee and spreader ditch) at differing flows.

Test predictions for spread based on the trials described in section 1.

## *2.2 Method*

The layout of the trial was as per figure 7.

Two lines were surveyed an pegged on the contour at approximately 10m intervals, with the maximum deviation from level at any peg being 3mm. A spreader ditch was constructed along each pegged line using a grader, with the profile of the ditch as per figure 6. During a previous trial (Muller 2005) it was identified that slumping of the edge of the spreader ditch in that trial and trampling by cattle had the potential to rapidly reduce the effectiveness of the ditch. The revised profile used in this trial aimed to eliminate slumping

For the lower spreader ditch the spoil was directed to the lower side to create a mound. This was breached at 5m intervals to create gaps approximately 0.5m wide. Care was taken to ensure the grader blade did not disturb the natural surface level during this breaching process, and the gaps were finished to the original surface level by hand.

For the upper spreader ditch, the spoil was directed to the top side, and the natural surface on the lower side left undisturbed.


cmconsult@gmail.com
Mobile 0418938223

**Picture 5: Spreader ditches: lower side undisturbed on upper ditch, and spoil on downslope side on lower ditch.**

**Picture 6: Levee construction**

A levee was constructed on the contour parallel to and downslope from the upper spreader ditch. The levee was constructed from 75-125 mm screened rock, based on the results of the trial outlined in section 1. Although specified to be screened the same, this rock was from a different source and wars not identical to the medium rock previously used, and provided an example of the variation that can be expected in practice. The percentage void for this rock is shown in the previous table 1.

The levee was again constructed with a loader, with the aim to make the levee between 0,75 and 1m wide. No hand trimming of the levee was undertaken to increase uniformity. Tipping of the rock was guided by an observer working in conjunction with the operator. Relatively uniform width was readily achieved.

**Picture 7: Finished levee wall**

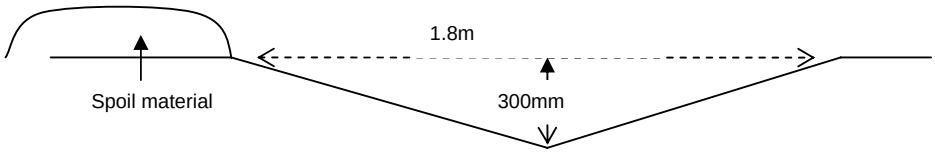


**Figure 6: Cross-section of spreader ditch**

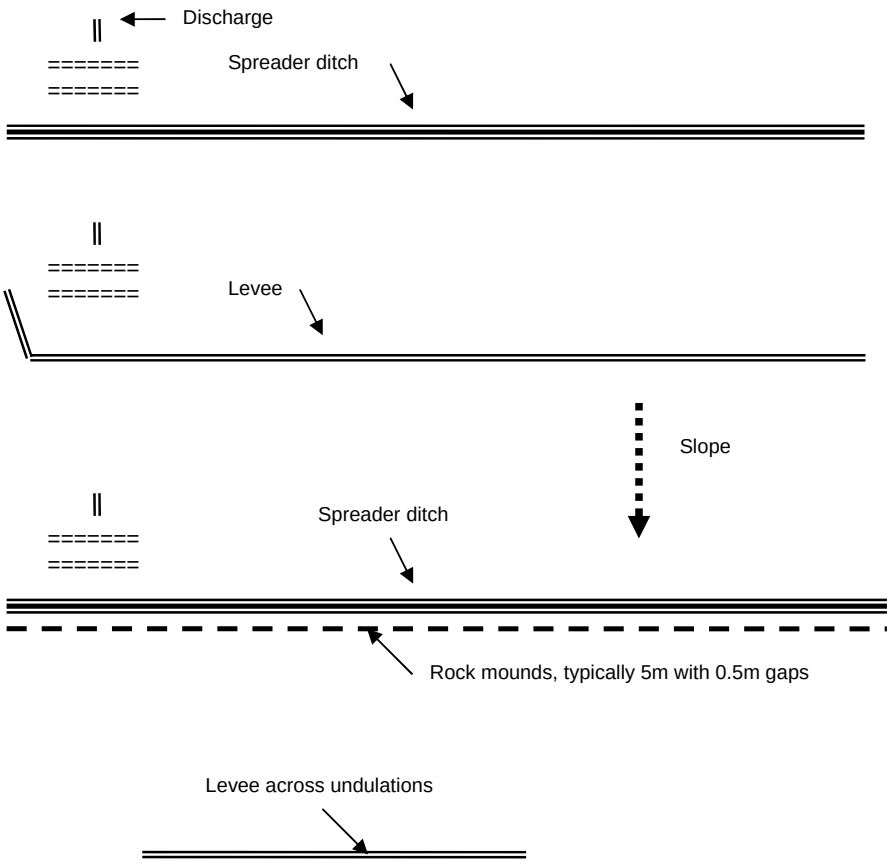


**Figure7: Arrangement of full scale trial**

A short levee was constructed with the remaining rock below the spreader ditch with the mounds. This was placed to cross a slight depression, to observe the effectiveness of spreading flow across undulating ground.

Flow trials were conducted with a “low” discharge rate of approximately 25 litres/second ((24.7 and 25.4 l/sec) and a”high” rate approximately 60 litres/sec (54.5 and 57.4 l/sec).

## *2.3 Results and Discussion*

At both low and high flows both spreader levees showed preferential discharge at low points (pictures 8), despite the care taken to prepare a level sill. If the water is unrestrained laterally, a few millimetres difference is enough to prevent discharge.


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**Picture 8: Preferential flow from spreader ditch.**

Flow occurred in only 12 of the 20 gaps in the wall below the spreader ditch, and over only portions of the lower sill of the spreader ditch without mounds. Whilst this makes the spreader ditches effective in reducing the concentration of water by spreading it over several discharge points and thus reducing erosion from point discharge, it means they are ineffective in re-establishing sheet flow.

The levee constructed on the contour was effective in spreading the water for at both low (25.4 l/s) and high (57.4 l/s) flows. In both cases water percolated through the levee for all of the length except very small sections where “fines” were inadvertently picked up by the loader bucket and were included in the levee wall, and one section that was marginally higher and was by-passed by water that flowed through the spreader ditch. (Pictures 9 and 10).

Highest percolation through the wall was near the discharge point, where the force of the discharge resulted in an increased depth, but this did not extend for a great distance.

Water spread laterally more rapidly in the adjacent spreader ditch, but spread occurred along most of the levee before the ditch over-topped (Picture 9). An adjacent upslope ditch has the benefit of spreading water past “rises” or undulations more readily and providing a more uniform discharge to the levee for spreading. This results in more uniform spread than would be the case with a levee alone, where the damming effect would result in a greater depth and higher flow through the levee on the section


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between the discharge point and the :rise". This would be more pronounced at lower flows.

**Picture 9: Levee in early stages of discharge at 24.7 l/sec. Note that the ditch has water in it, but that the spread of water along the levee is due to the levee itself.**

**Picture 10: Levee with discharge 57.4 l/sec**

Discharge was near one end of the levee, and water was required to travel for the full length of the levee. To prevent the water discharging preferentially at the end near the discharge point, a short return levee wall was constructed. To prevent excess "leakage" around the end of the levee from flows from the ditch (particularly if the ditch is slightly low at the end point), a short return levee should be included at both ends.


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Drainage from the gaps in the lower spreader ditch did not re-establish sheet flow immediately, but followed a preferential path until it encountered the levee that had been constructed across the undulations. (Picture 11). It then backed up to spread across all the land between the levee and the ditch, and spread below the levee along the full length of the levee.

**Picture 11: Levee across undulations, start day 2. Initial flow from gaps in the spreader ditch has been channelled in the depression, until it reaches the wall. The dark areas show the extent of back-up and sheet flow from the previous day's trial.**

The lower levee was in the flattest part of the area, and the variation in levels (ie the undulations) were only 25mm. This was sufficient to cause channelling, but there was no difficulty in this being spread by the levee.


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Mobile 0418938223

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# 3 High Discharge Events

## *3.1 Objective*

1 To determine if modification to levee design is required to withstand the potential maximum discharge through 300mm diameter corrugated steel culvert.

2 To determine the potential for spreader levees to be used for culverts larger than the proposed 300mm "environmental culverts", with higher flow rates.

The maximum culvert discharge will occur in the event of floodwaters reaching the top of the railway embankment (ie maximum head). Assuming a 1.2m embankment height, the maximum discharge through a 300mm corrugated steel culvert on a 1% slope is calculated to be 170 litres/second (Vince Piper (Aquaterra), pers. comm.).

## *3.2 Method*

Discharge rates of up to 26 litres/sec were included in the first series of trials described in section1.

For stage 2 the diverter valve was shifted to permit discharge through the 8" valve into the bays. Discharge was into the small rock levee, and from there flowed through the medium and large rock levees. The valve was s et up approximately 10m from the levee wall, simulating the likely minimum distance from the culvert if discharge was across a road.

The bunds between the bays were breached, allowing water to flow across the full 40m of each levee wall. The end bunds were retained to confine the water to the width of the levees.

As the flow meter could not be used on the 8" layflat, all flow was initially diverted through the 140mm ID poly line and flow recorded. The 8" valve was then opened, and the 6" valve closed, with the pump settings remaining unaltered. Flow through the 8" line was then estimated by applying corrections from the pump flow charts.

## *3.3 Results and Discussion*

In the stage 1 trials it was observed that percolation through the levee wall increased The flow through the 140mm ID poly pipe was 100 litres/sec. With a conservative assumption of a 25% reduction in head (allowing for increased turbulence) the estimated flow through the 8" valve is 167 litres/second. This is close to the predicted maximum flow of 170 litres/sec..


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There was no sign of damage to the levees at this flow rate.

The discharge point for the levee trial was within a few metres of the levee wall, with a high discharge velocity (see picture 12). There was no damage to the levee wall. Additional protection for the levees for flows through the "environmental" 300mm diameter culverts would not be required.

**Picture 12: Discharge at 57.4 litres/sec**

During the stage 1 trials it was noted that permeability of the levee wall increased markedly with depth at discharge rates of up to 26 litres/sec into individual (nominally) 10m wide bays. This was the maximum discharge that could be confined to individual bays, as the water flowed around the retaining bunds at higher rates. The water in those trials did not reach near the top of the levee wall.

During the maximum discharge trial the levees were also not over-topped (see pictures 13 and 14), although some of the walls were narrower with height, allowing much more water to flow through them.

Not only are these rock levees able to withstand flow rates much higher than the 67 litres/sec maximum design flow for the environmental culverts, but they are able to spread water effectively at much higher rates. Similar levees therefore would appear to be suitable for re-distributing flow in sensitive areas where it may be necessary to use culverts greater than 300mm diameter. However, as the limits of the ability to withstand washing away were not reached during this trial, it may be prudent to include extra rip-rap if they are to be used with much larger culverts.


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**Picture 13: Discharge @ approx. 170 l/sec**

**Picture 14: Peak capacity of 40 m of levee at 170 l/sec discharge**

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# 4 Sediment loads

## *4.1 Objective*

To determine potential impact of high sediment loads in water on the long term effectiveness of spreader levees.

## *4.2 Method*

High flow through a 6" hose was used to wash away the internal earth bunds in the medium rock levee. (Picture 15).

Parts of the medium and large levees w
silt loading examined.

The mechanical properties of soil samp
at Fortescue Marsh were compared by a

**Picture 15: Creating sediment**

## *4.3 Results and Discussion*

A high silt load was achieved, with ar
across the 40 metres of levee. The depth of the holes in the silt remaining after the levee rocks were removed was between 45mm and 80mm. It is likely some of this depth is attributable to the rocks sinking into the softened soil, rather than sedimentation as such, as the soil became very soft when wet.

**Picture 16a and 16b: Silt in levee after sedimentation trial**

Sedimentation did not visibly affect performance of the levee, as the total height of the levee was far greater than the depth of sediment. In the early stages of sedimentation, performance of the levee can be expected to improve through more uniform distribution as the sediment creates a level sill for the bottom of the levee.

A considerable amount of the sediment flowed through the levee (Picture17), and unlike "fines" included during construction, did not have an impact on the permeability. However, where fines are included, such silt will be trapped, rendering the levee impermeable.

It is anticipated that a levee would last for many floods before sedimentation created a problem. Construction of a spreader ditch in conjunction with the levee will not only aid in water distribution, but will also act to trap much of the sediment, as the water will be slowed down prior to reaching the levee. Removal of silt build-up from these ditches is a simple matter.

In the event that the levees cease to function due to sedimentation, it is relatively simple to remove and replace the levees.

A comparison of the material from Fortescue Marsh area (picture 18a and from the trial site at Woodie Woodie (picture 18b) showed a much higher proportion of fine clay and silt components in the soil from the trial site. The fine sand fraction that was a significant component of the mulga soil was absent from the trial site soil. This fraction settled very quickly and is the fraction most likely to settle in the spreader ditch.

**Picture 17: Silt downstream of levee**


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**Picture 18a and b. Soil from mulga area (left) and Woodie Woodie**

A mix of the red mulga silt/clay fraction and the pale Woodie Woodie soil showed no differentiation between the two (picture 19).


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**Picture 19: L to R: Mulga silt, Woodie Woodie, mixed mulga and Woodie Woodie. There is no diffeentison visinle in the soil fractions from the two areas when mixed and allwed to settle.**


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Mobile 0418938223

# 5 Susceptibility to cattle damage

## *5.1 Objective*

Observe the resistance of spreader structures to mechanical damage, as from trampling by cattle;

## *5.2 Results and Discussion*

At the earlier trial at Fortescue marsh, cattle were quickly attracted to the water, and caused significant damage to the spreader ditches.

At Woodie Woodie there were fewer cattle, and much more water in the area, so that they were not attracted to the trial. However, the levees received considerable traffic from the trial participants once the trial started, as the areas that were flooded become untrafficable. Despite repeated use, there was no evidence of any damage to the levees.


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**Picture 20: Brown stain on top of levee the only evidence of repeated walking. Wet soil very soft.**

In addition to the spreader ditches being very sensitive to slight changes in the height of the sill, they are highly vulnerable to damage. Even if the earth mounds are replaced with rock, the gaps in between become very soft, and any effectiveness of the spreader ditch would quickly be destroyed if cattle (or people) walk through these gaps whilst the ground is soft.

# 6 Conclusions and Recommendations

These trials have demonstrated that in mulga flats discharge from culverts can be effectively re-distributed so as to re-establish sheet flow. Regular inspection and maintenance will be required to ensure they continue to perform as designed for the life of the infrastructure.

In flat areas, water will temporarily build up on the upstream side of the levees. The duration of any such ponding can be expected to increase if silt loads raise the effective sill height of the levee.
Unless there is general flooding of the entire area, any ponding should drain away within a few hours of discharge ceasing, and should therefore not adversely affect any vegetation. However, the extended period of inundation may impact on the trafficability of roads.

To re-spread water as quickly as possible and so minimise any area potentially affected by drainage shadow, the levee spreader structure should be constructed as close to the rail/road as practicable. To maintain a trafficable surface adjacent to a levee the road could be built slightly higher than the surrounding land, and culverts either pass under the road as well as the rail, or the road surface dip to natural surface level and stabilised floodways constructed.

It is recommended that in areas of vegetation sensitive to interference with sheet flow:

- spreader structures consisting of a ditch and levee be constructed along the contour, as near as practicable to the road/rail.
- Levees be constructed of clean rock material screened in the range 75-125mm.
- Levees be constructed between 700mm and 1000mm wide, and at least 2-300mm high.
- Short return levee walls be constructed at each end of the levee.


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Mobile 0418938223

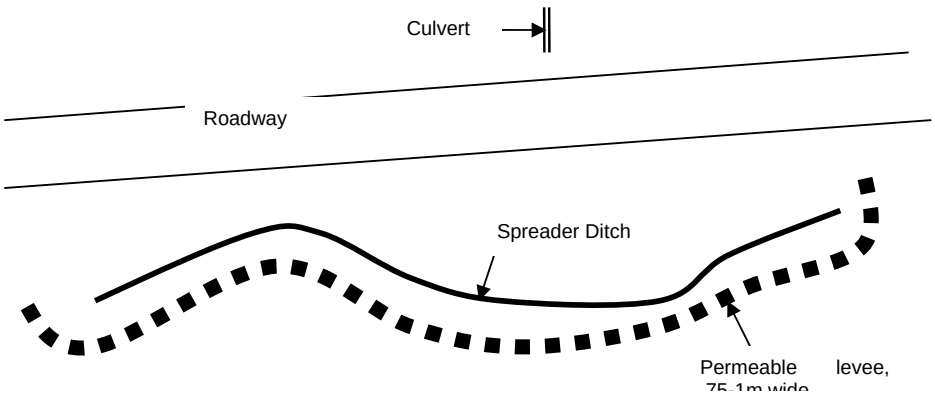


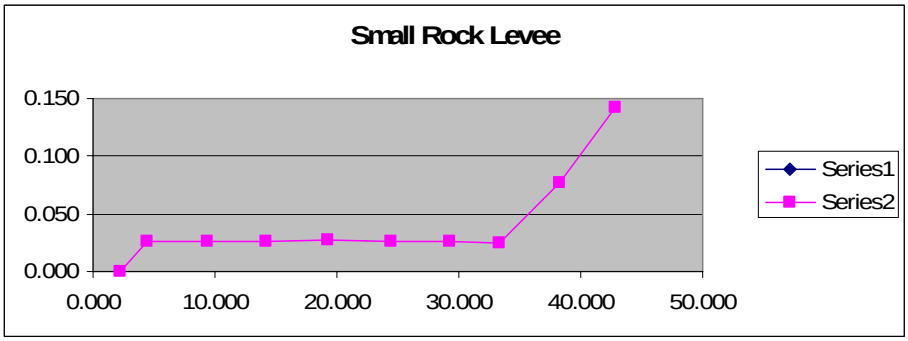

**Figure 6: Recommended layout for spreader structures**
**(Not to scale)**

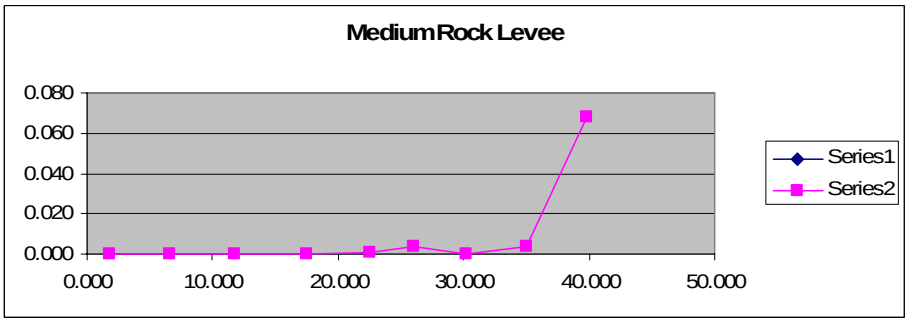
## Acknowledgements

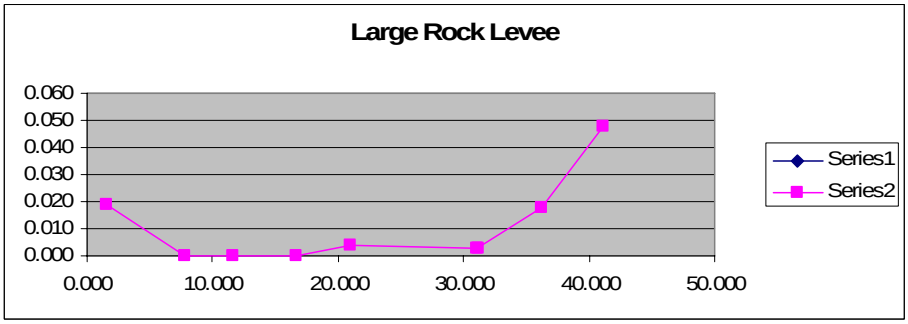
I wish to thank:

- Consolidated Minerals for permitting us to conduct the trials on their mining lease, and for the support provided.
- Consolidated minerals staff and contractors who provided assistance on site.
- Ben Garnett from Fortescue Metals Limited, who arranged the logisitics for the trial, as well as participated in it.
- Craig ?? from FMG, "shopper" and Mr Fixit extraordinaire, for his assistance during the trial.

# Appendix: 1 Profile of initial trial levee sites



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Mobile 0418938223

# Appendix 2: Linear Regression Analyses

## 1. Effect of levee width on flow

### *1.1 Large rock, flow/m of levee <1.5 l/sec*

analysed with: Analyse-it + General 1.71

| | |
|---|---|
| **Test** | **Linear regression** |
| | Large: Flow / m < 1.5 l / sec |
| **Fit** | Flow/m v Width |
| **Performed by** | Chris |
| **Date** | 18 June 2005 |

| | |
|---|---|
| **n** | 10 |
| **$R^2$** | 0.10 |
| **Adjusted $R^2$** | -0.01 |
| **SE** | 0.1759 |

| Term | Coefficient | SE | p | 95% CI of Coefficient |
|---|---|---|---|---|
| **Intercept** | 0.9206 | 0.1539 | 0.0003 | 0.5656to 1.2756 |
| **Slope** | -0.1530 | 0.1613 | 0.3705 | -0.5250to 0.2189 |

| Source of variation | SSq | DF | MSq | F | p |
|---|---|---|---|---|---|
| **Due to regression** | 0.03 | 1 | 0.03 | 0.90 | 0.3705 |
| **About regression** | 0.25 | 8 | 0.03 | | |
| **Total** | 0.28 | 9 | | | |

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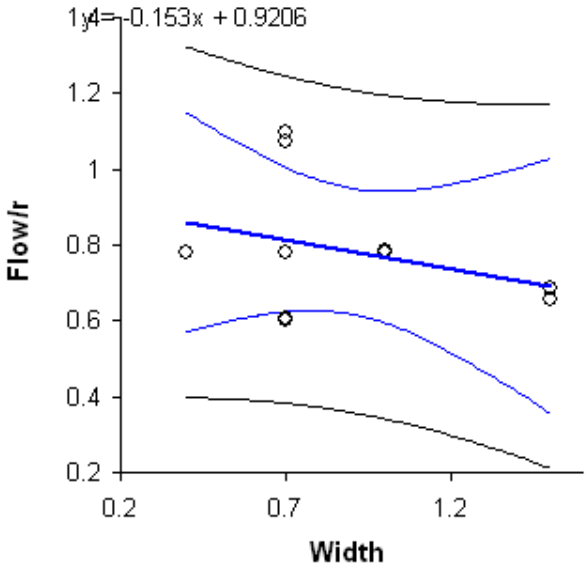


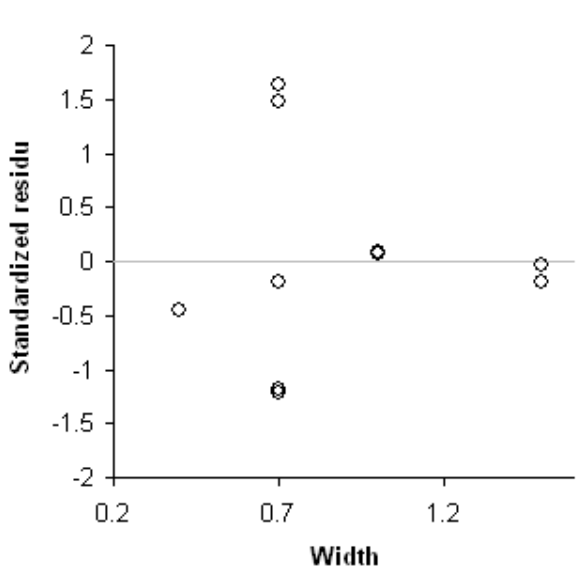


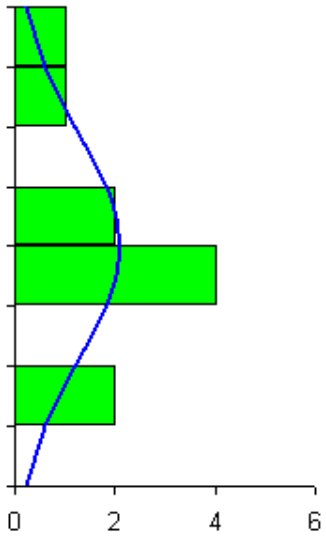


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## *1.2 Medium rock, flow/m of levee <1.5 l/sec*

analysed with: Analyse-it + General 1.71

| | |
|---|---|
| **Test** | **Linear regression** |
| | Medium Rock: flow/m < 1.5 l/s |
| **Fit** | Flow/m v Width |
| **Performed by** | Chris |
| **Date** | 18 June 2005 |

| | |
|---|---|
| **n** | 11 |
| **$R^2$** | 0.54 |
| **Adjusted $R^2$** | 0.48 |
| **SE** | 0.1773 |

| Term | Coefficient | SE | p | 95% CI of Coefficient |
|---|---|---|---|---|
| **Intercept** | 1.2095 | 0.1488 | <0.0001 | 0.8728to 1.5461 |
| **Slope** | -0.4971 | 0.1543 | 0.0105 | -0.8462to -0.1481 |

| Source of variation | SSq | DF | MSq | F | p |
|---|---|---|---|---|---|
| **Due to regression** | 0.326 | 1 | 0.326 | 10.38 | 0.0105 |
| **About regression** | 0.283 | 9 | 0.031 | | |
| **Total** | 0.609 | 10 | | | |

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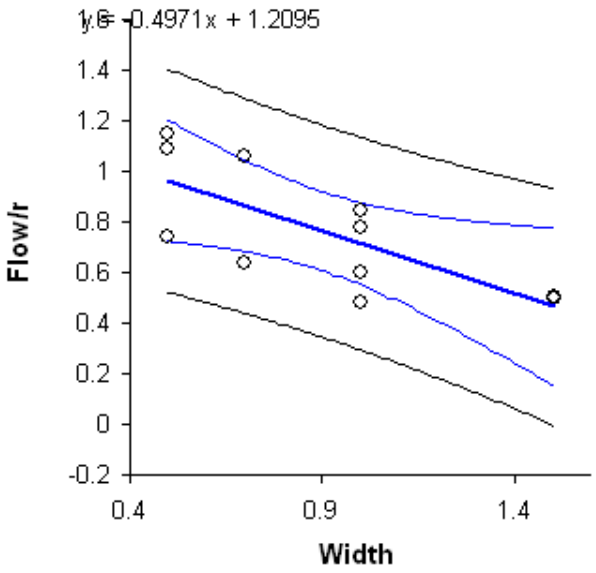


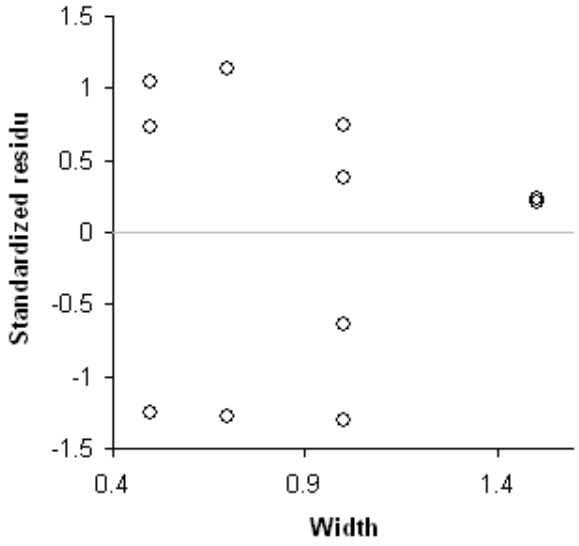


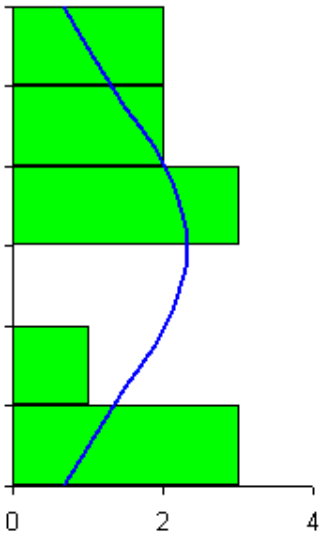


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## *1.3 Small Rock, flow/m of levee < 1.5 l/sec*

| | | | |
|---|---|---|---|
| | | | analysed with: Analyse-it + General 1.71 |
| **Test** | **Linear regression**<br>Small: flow / m < 1.5 l / sec | | |
| **Fit** | Flow/m v Width | | |
| **Performed by** | Chris | **Date** | 18 June 2005 |

| | |
|---|---|
| **n** | 12 |
| **$R^2$** | 0.78 |
| **Adjusted $R^2$** | 0.76 |
| **SE** | 0.0777 |

| Term | Coefficient | SE | p | 95% CI of Coefficient |
|---|---|---|---|---|
| **Intercept** | 1.6176 | 0.0708 | <0.0001 | 1.4599to 1.7753 |
| **Slope** | -0.3644 | 0.0610 | 0.0001 | -0.5004to -0.2284 |

| Source of variation | SSq | DF | MSq | F | p |
|---|---|---|---|---|---|
| **Due to regression** | 0.215 | 1 | 0.215 | 35.66 | 0.0001 |
| **About regression** | 0.060 | 10 | 0.006 | | |
| **Total** | 0.275 | 11 | | | |

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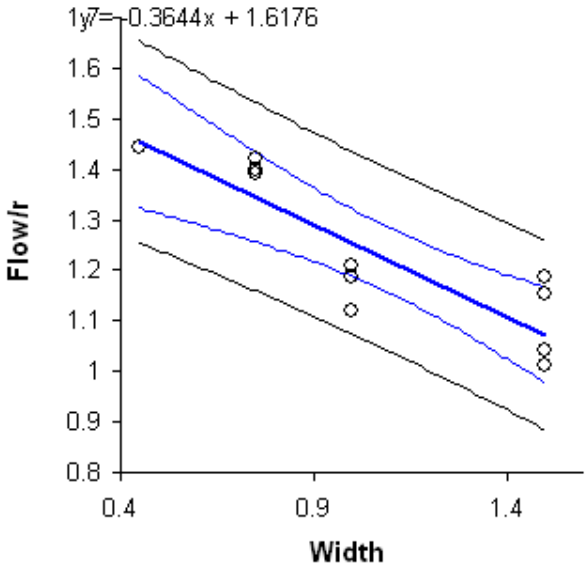


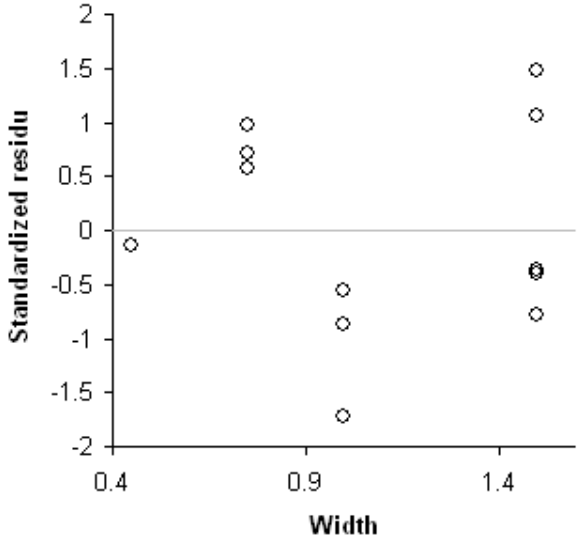


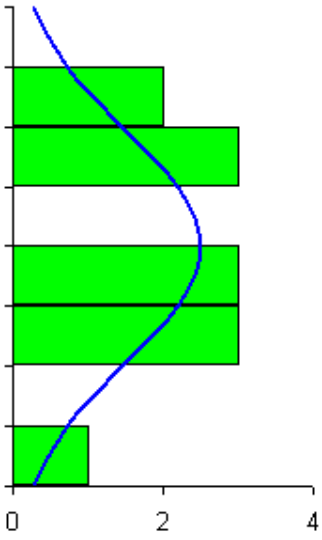


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## *1.4 All rock sizes combined, flow/m of levee < 1.5 l/sec.*

analysed with: Analyse-it + General 1.71

| | |
|---|---|
| **Test** | **Linear regression** |
| | Flow Trials: flow / m < 1.5 l/sec |
| **Fit** | Flow/m v Average Width |
| **Performed by** | Chris |
| **Date** | 18 June 2005 |

| | |
|---|---|
| **n** | 33 |
| **$R^2$** | 0.06 |
| **Adjusted $R^2$** | 0.03 |
| **SE** | 0.2807 |

| Term | Coefficient | SE | p | 95% CI of Coefficient |
|---|---|---|---|---|
| **Intercept** | 1.1039 | 0.1317 | <0.0001 | 0.8353to 1.3725 |
| **Slope** | -0.1839 | 0.1350 | 0.1830 | -0.4592to 0.0914 |

| Source of variation | SSq | DF | MSq | F | p |
|---|---|---|---|---|---|
| **Due to regression** | 0.146 | 1 | 0.146 | 1.86 | 0.1830 |
| **About regression** | 2.442 | 31 | 0.079 | | |
| **Total** | 2.589 | 32 | | | |

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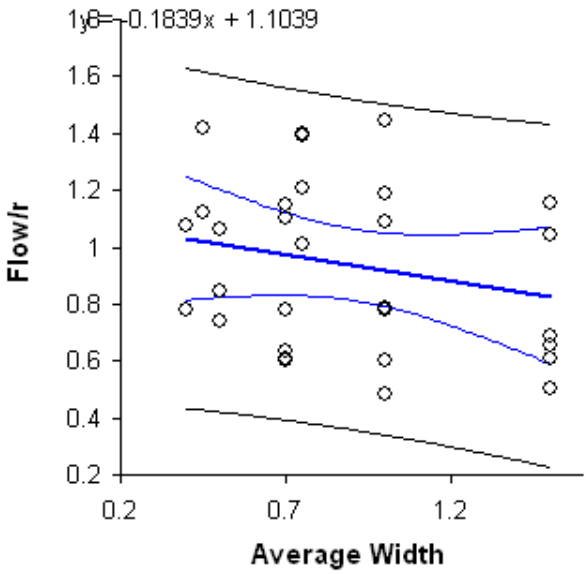


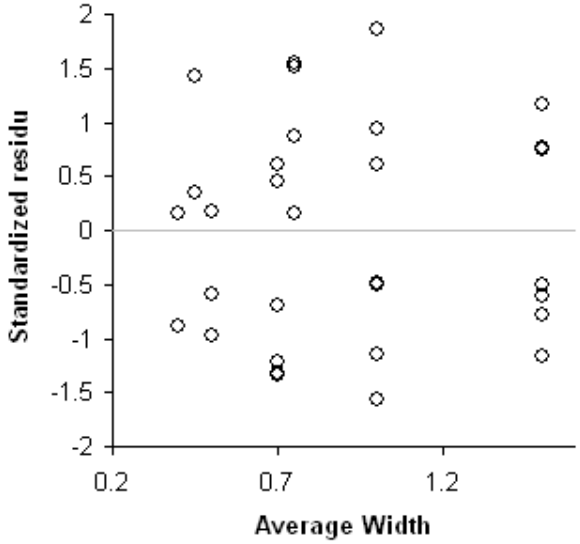


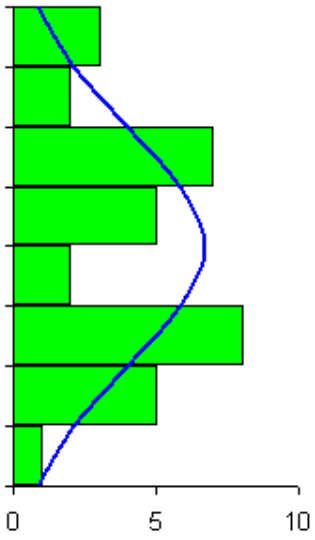


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# 2. Effect of rock size on flow

## *2.1 Levee width 1.5m. Flow/m of levee < 1.5 l/sec*

analysed with: Analyse-it + General 1.71

| | | | |
|---|---|---|---|
| **Test** | **Linear regression** | | |
| | Flow Trials: flow / m < 1.5 l/sec Levee Width 1.5m | | |
| **Fit** | Flow/m v Mean Rock Size | | |
| **Performed by** | Chris | **Date** | 19 June 2005 |

| | |
|---|---|
| **n** | 7 |
| **$R^2$** | 0.55 |
| **Adjusted $R^2$** | 0.46 |
| **SE** | 0.1888 |

| Term | Coefficient | SE | p | 95% CI of Coefficient |
|---|---|---|---|---|
| **Intercept** | 1.2387 | 0.1854 | 0.0011 | 0.7622to 1.7151 |
| **Slope** | -0.0045 | 0.0018 | 0.0551 | -0.0092to 0.0001 |

| Source of variation | SSq | DF | MSq | F | p |
|---|---|---|---|---|---|
| **Due to regression** | 0.221 | 1 | 0.221 | 6.20 | 0.0551 |
| **About regression** | 0.178 | 5 | 0.036 | | |
| **Total** | 0.399 | 6 | | | |

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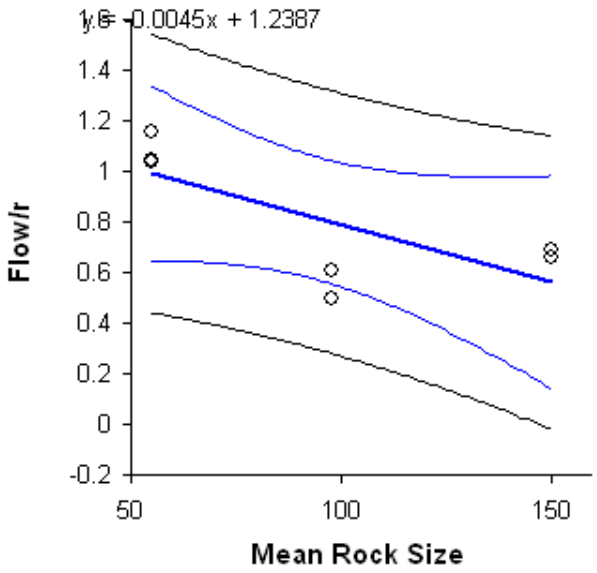
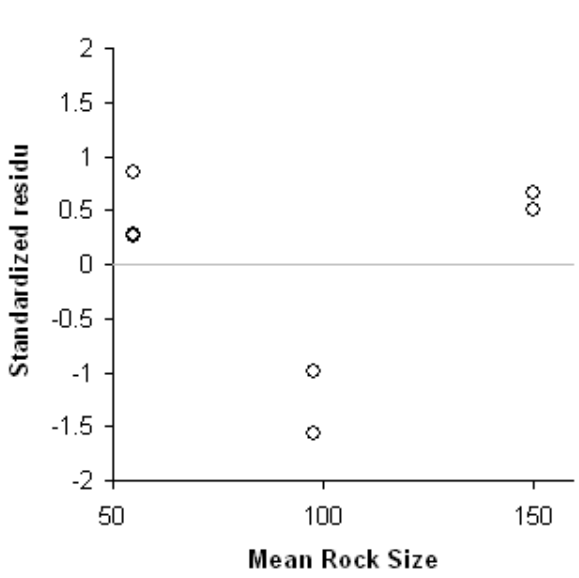
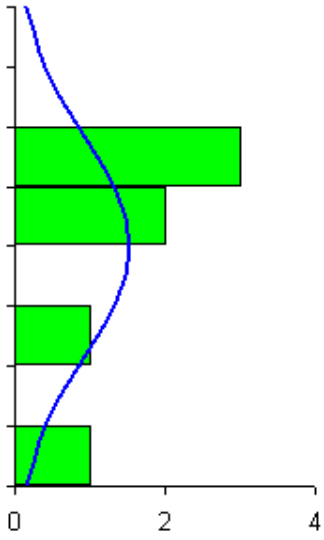
Mobile 0418938223

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**ABN 63 195 874 227**
cmconsult@gmail.com
Mobile 0418938223

## 2.2 Levee width 1.0m. Flow/m of levee < 1.5 l/sec

analysed with: Analyse-it + General 1.71

| | |
|---|---|
| **Test** | **Linear regression** |
| | Flow Trials: flow / m < 1.5 l/sec Levee Width 1.0 m |
| **Fit** | Flow/m v Mean Rock Size |
| **Performed by** | Chris |
| **Date** | 19 June 2005 |

| | |
|---|---|
| **n** | 9 |
| **$R^2$** | 0.41 |
| **Adjusted $R^2$** | 0.33 |
| **SE** | 0.2593 |

| Term | Coefficient | SE | p | 95% CI of Coefficient |
|---|---|---|---|---|
| **Intercept** | 1.4470 | 0.2520 | 0.0007 | 0.8512to 2.0429 |
| **Slope** | -0.0055 | 0.0025 | 0.0633 | -0.0114to 0.0004 |

| Source of variation | SSq | DF | MSq | F | p |
|---|---|---|---|---|---|
| **Due to regression** | 0.327 | 1 | 0.327 | 4.86 | 0.0633 |
| **About regression** | 0.471 | 7 | 0.067 | | |
| **Total** | 0.798 | 8 | | | |

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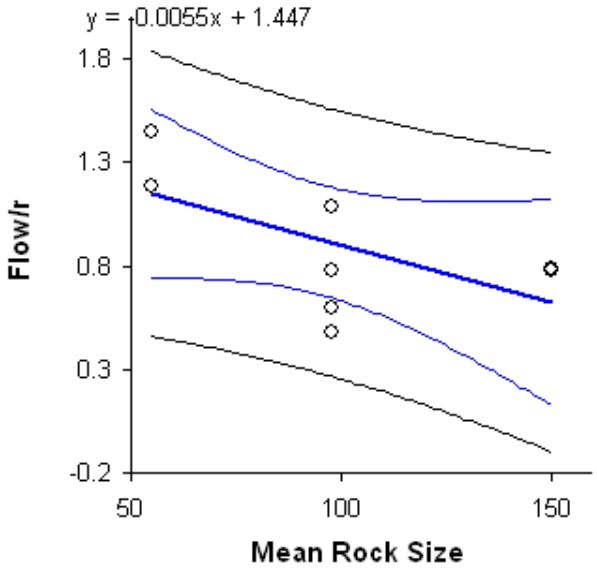


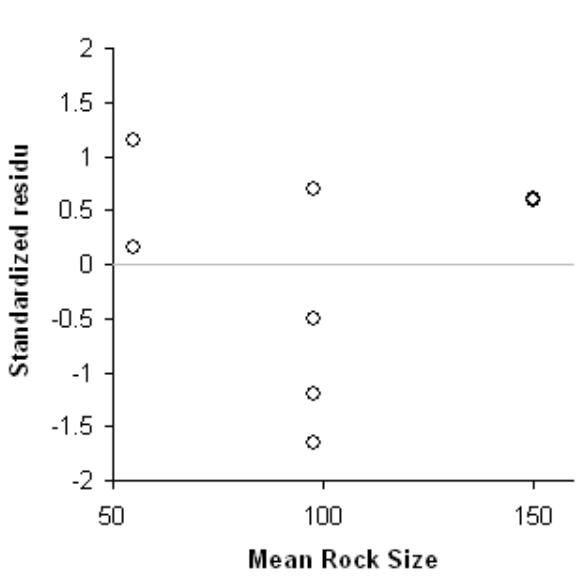


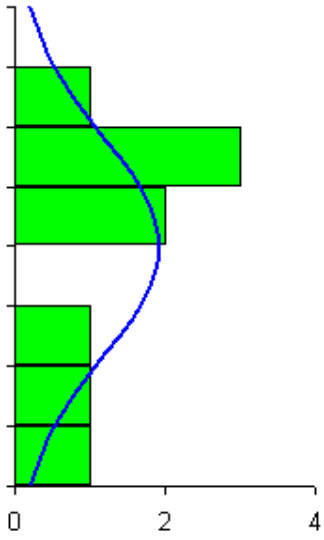


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Mobile 0418938223

## 2.3 Levee width 0.7-0.75m. Flow/m of levee < 1.5 l/sec

analysed with: Analyse-it + General 1.71

| | |
|---|---|
| **Test** | **Linear regression** |
| | Flow Trials: flow / m < 1.5 l/sec Levee Width 0.70-0.75 m |
| **Fit** | Flow/m v Mean Rock Size |
| **Performed by** | Chris |
| **Date** | 19 June 2005 |

| | |
|---|---|
| **n** | 10 |
| **$R^2$** | 0.51 |
| **Adjusted $R^2$** | 0.45 |
| **SE** | 0.2316 |

| Term | Coefficient | SE | p | 95% CI of Coefficient |
|---|---|---|---|---|
| **Intercept** | 1.4965 | 0.1897 | <0.0001 | 1.0591to 1.9339 |
| **Slope** | -0.0050 | 0.0017 | 0.0197 | -0.0090to -0.0010 |

| Source of variation | SSq | DF | MSq | F | p |
|---|---|---|---|---|---|
| **Due to regression** | 0.453 | 1 | 0.453 | 8.45 | 0.0197 |
| **About regression** | 0.429 | 8 | 0.054 | | |
| **Total** | 0.882 | 9 | | | |

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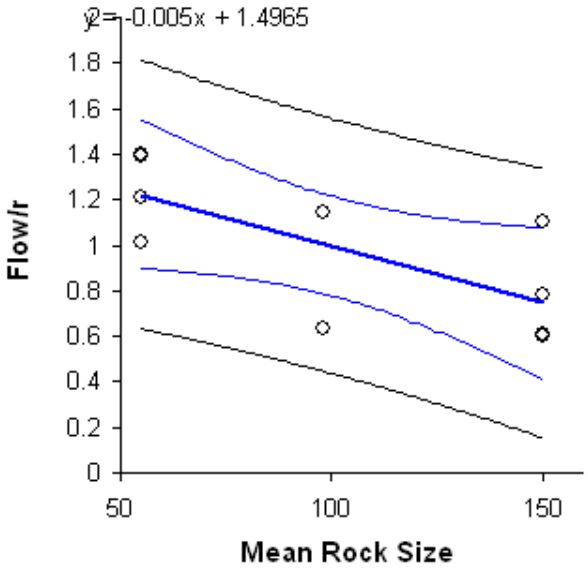


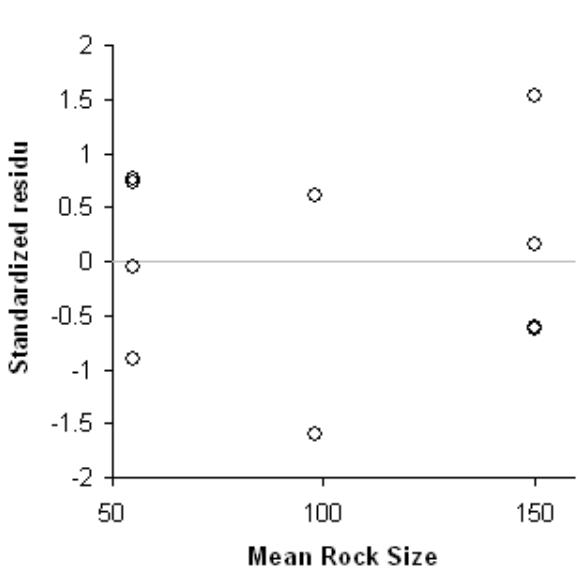


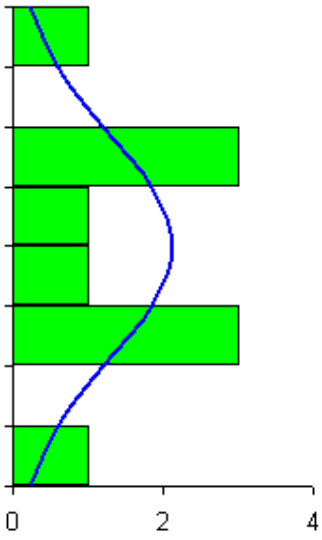


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cmconsult@gmail.com
Mobile 0418938223

## *2.4 Levee width 04-0.5m. Flow/m of levee < 1.5 l/sec*

analysed with: Analyse-it + General 1.71

| | |
|---|---|
| **Test** | **Linear regression** |
| | Flow Trials: flow / m < 1.5 l/sec Levee Width 0.4-0.5 m |
| **Fit** | Flow/m v Mean Rock Size |
| **Performed by** | Chris |
| **Date** | 19 June 2005 |

| | |
|---|---|
| **n** | 7 |
| **$R^2$** | 0.31 |
| **Adjusted $R^2$** | 0.17 |
| **SE** | 0.2168 |

| Term | Coefficient | SE | p | 95% CI of Coefficient |
|---|---|---|---|---|
| **Intercept** | 1.3490 | 0.2433 | 0.0026 | 0.7237to 1.9743 |
| **Slope** | -0.0034 | 0.0023 | 0.1941 | -0.0093to 0.0024 |

| Source of variation | SSq | DF | MSq | F | p |
|---|---|---|---|---|---|
| **Due to regression** | 0.106 | 1 | 0.106 | 2.25 | 0.1941 |
| **About regression** | 0.235 | 5 | 0.047 | | |
| **Total** | 0.341 | 6 | | | |

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cmconsult@gmail.com
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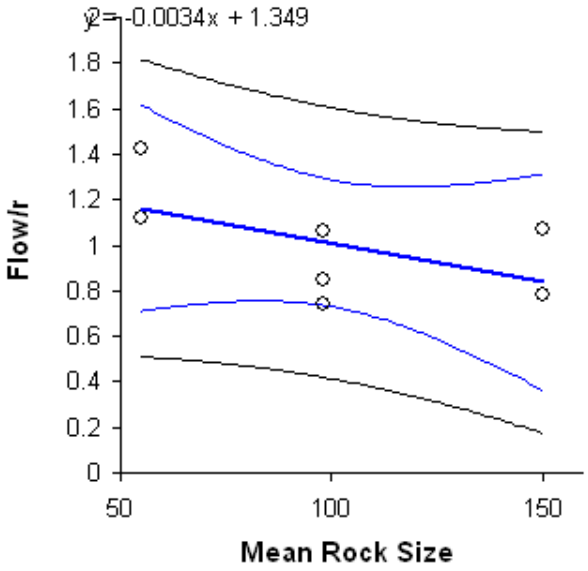


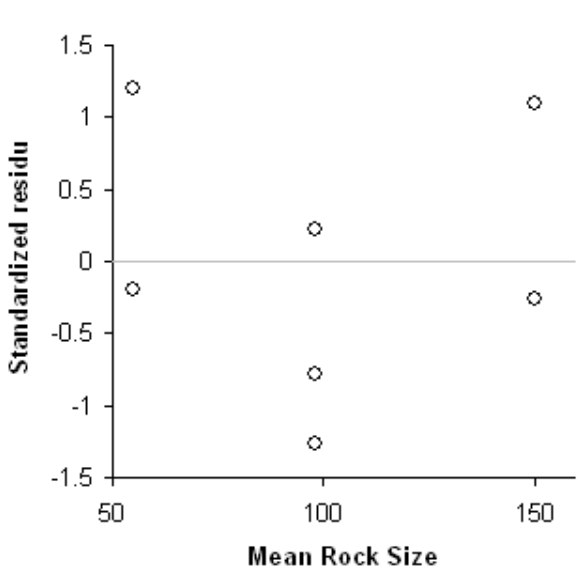


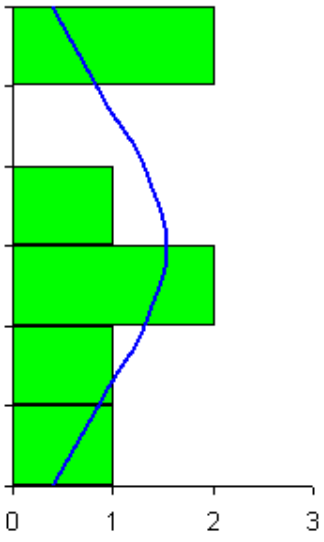


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## 2.5 *All bays in the three levies combined. Flow/m of levee < 1.5 l/sec.*

analysed with: Analyse-it + General 1.71

| | |
|---|---|
| **Test** | **Linear regression** |
| | Flow Trials: flow / m < 1.5 l/sec |
| **Fit** | Flow/m v Mean Rock Size |
| **Performed by** | Chris |
| **Date** | 18 June 2005 |

| | |
|---|---|
| **n** | 33 |
| **$R^2$** | 0.39 |
| **Adjusted $R^2$** | 0.37 |
| **SE** | 0.2252 |

| Term | Coefficient | SE | p | 95% CI of Coefficient |
|---|---|---|---|---|
| **Intercept** | 1.3832 | 0.1070 | <0.0001 | 1.1649to 1.6015 |
| **Slope** | -0.0045 | 0.0010 | <0.0001 | -0.0066to -0.0025 |

| Source of variation | SSq | DF | MSq | F | p |
|---|---|---|---|---|---|
| **Due to regression** | 1.016 | 1 | 1.016 | 20.04 | <0.0001 |
| **About regression** | 1.572 | 31 | 0.051 | | |
| **Total** | 2.589 | 32 | | | |

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cmconsult@gmail.com
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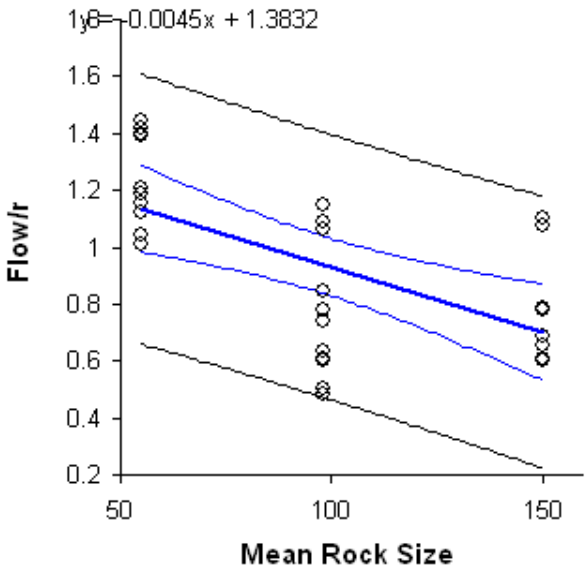


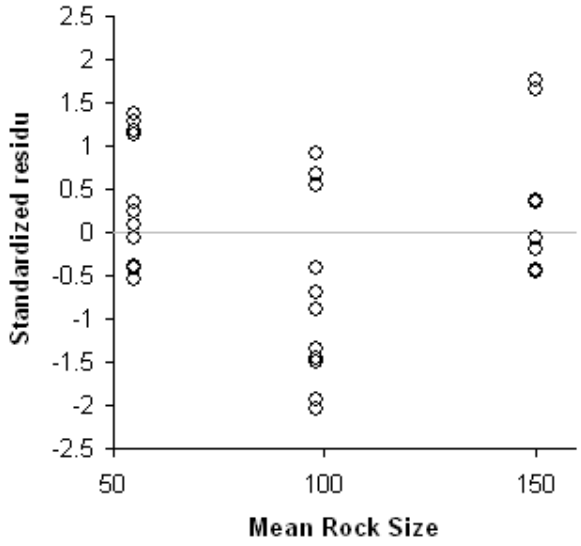


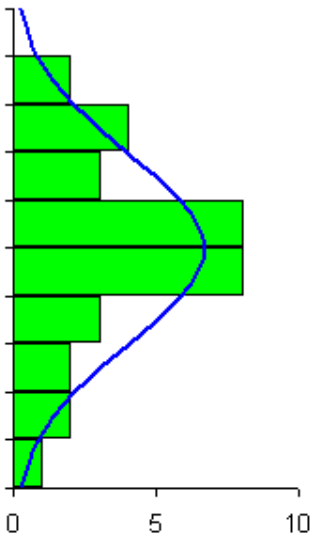


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**ABN 63 195 874 227**
cmconsult@gmail.com
Mobile 0418938223

# 3. Combined effects of rock/void size, levee width and depth of flow rates

## *3.1. Multiple linear regression: Rock Size, Water Depth, Levee Width vs Flow/m with flow/m < 1.5 l/sec*

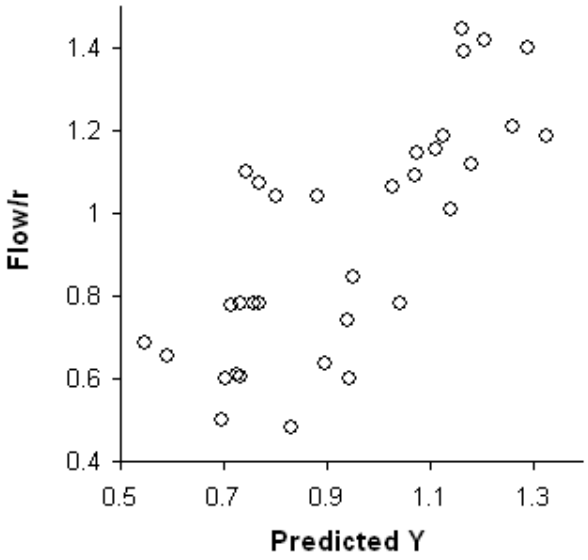
analysed with: Analyse-it + General 1.71

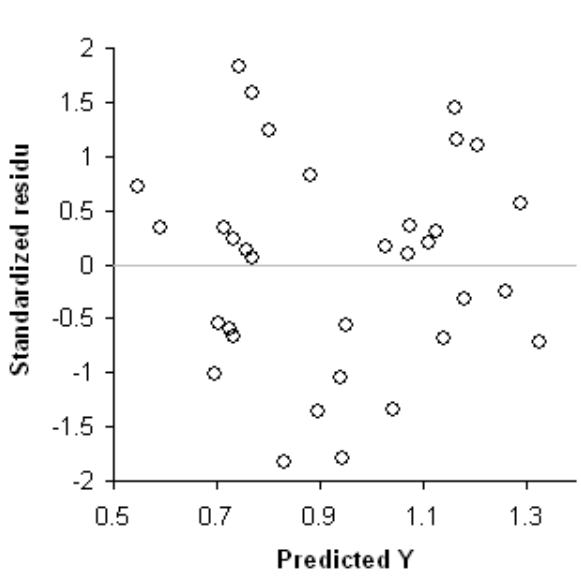
| | |
|---|---|
| **Test** | **Linear regression** |
| | Flow Trials: flow/m < 1.5 l/sec |
| **Fit** | Flow/m v Mean Rock Size, Average Width, Average Depth |
| **Performed by** | Chris **Date** 17 June 2005 |

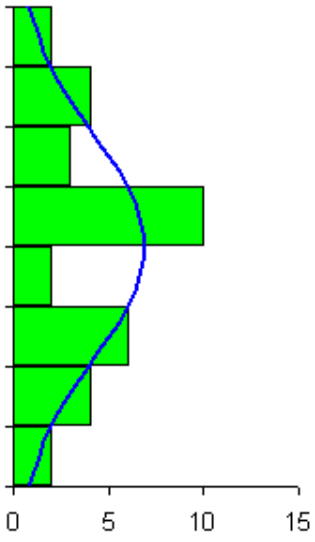
| | |
|---|---|
| **n** | 33 |
| **$R^2$** | 0.58 |
| **Adjusted $R^2$** | 0.54 |
| **SE** | 0.1936 |

| Term | Coefficient | SE | p | 95% CI of Coefficient |
|---|---|---|---|---|
| **Intercept** | 1.1796 | 0.2150 | <0.0001 | 0.7399to 1.6193 |
| **Mean Rock Size** | -0.0032 | 0.0011 | 0.0065 | -0.0054to -0.0010 |
| **Average Width** | -0.2152 | 0.0939 | 0.0293 | -0.4073to -0.0232 |
| **Average Depth** | 0.0059 | 0.0023 | 0.0154 | 0.0012to 0.0107 |

| Source of variation | SSq | DF | MSq | F | p |
|---|---|---|---|---|---|
| **Due to regression** | 1.502 | 3 | 0.501 | 13.36 | <0.0001 |
| **About regression** | 1.087 | 29 | 0.037 | | |
| **Total** | 2.589 | 32 | | | |

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**ABN 63 195 874 227**
cmconsult@gmail.com
Mobile 0418938223

## 3.2 Ratio Mean Void Area/Levee Width vs Flow for flow/m <1.5 l/sec.

Notes:

1 Mean void area = area of wet levee face * void%
2 Area wet levee face = effective length (m) * average depth (m)
3 Width (m)
4 Flow = total flow

analysed with: Analyse-it + General 1.71

| | | | |
|---|---|---|---|
| **Test** | **Linear regression** | | |
| | Flow Trials: flow/m < 1.5 l/sec | | |
| **Fit** | Flow v Mean Void Area / Width | | |
| **Performed by** | Chris | **Date** | 17 June 2005 |

| | |
|---|---|
| **n** | 33 |
| **$R^2$** | 0.67 |
| **Adjusted $R^2$** | 0.66 |
| **SE** | 1.7500 |

| Term | Coefficient | SE | p | 95% CI of Coefficient |
|---|---|---|---|---|
| **Intercept** | 4.0345 | 0.6543 | <0.0001 | 2.7001to 5.3688 |
| **Slope** | 17.5166 | 2.2166 | <0.0001 | 12.9958to 22.0374 |

| Source of variation | SSq | DF | MSq | F | p |
|---|---|---|---|---|---|
| **Due to regression** | 191.255 | 1 | 191.255 | 62.45 | <0.0001 |
| **About regression** | 94.940 | 31 | 3.063 | | |
| **Total** | 286.195 | 32 | | | |

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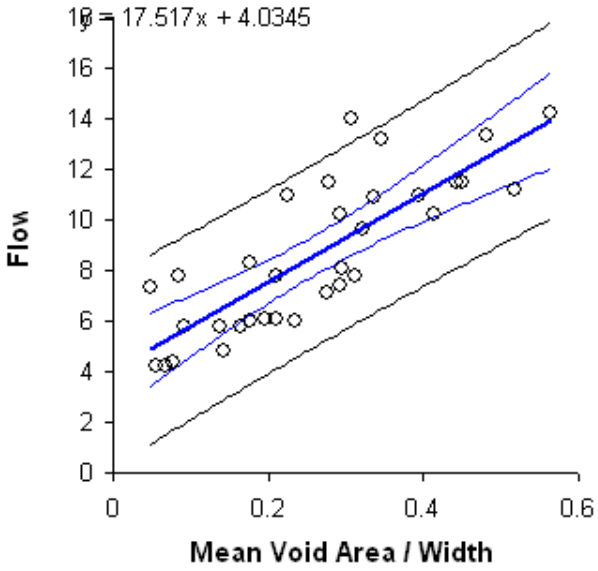
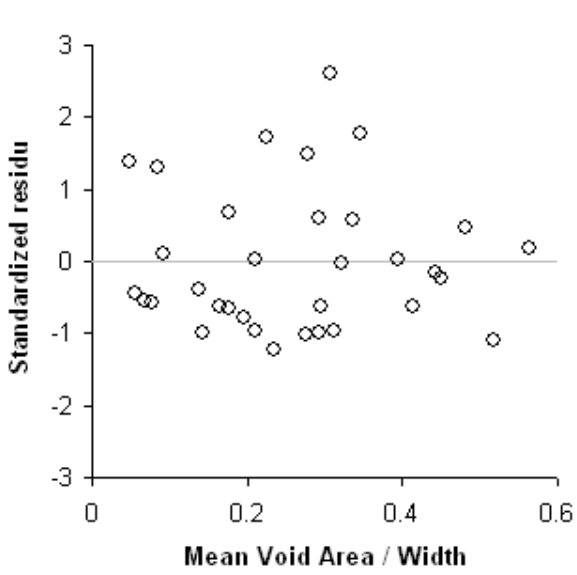
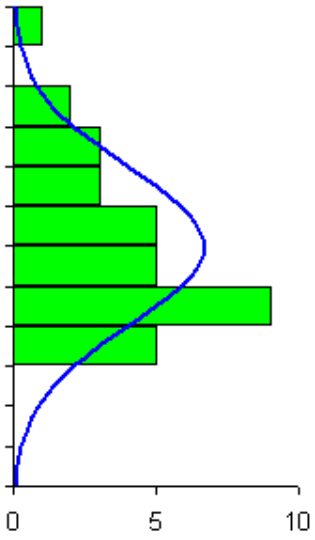
cmconsult@gmail.com
Mobile 0418938223

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**ABN 63 195 874 227**
cmconsult@gmail.com
Mobile 0418938223

# 4. Effect of water depth

## *4.1 Medium rock (screened 75-125 mm), levee width 0.7-1.0 m*

analysed with: Analyse-it + General 1.71

| | |
|---|---|
| **Test** | **Linear regression** |
| | Flow Trials: flow / m < 1.5 l/sec Medium rock |
| **Fit** | Flow/m v Average Depth |
| **Performed by** | Chris |
| **Date** | 19 June 2005 |

| | |
|---|---|
| **n** | 6 |
| **$R^2$** | 0.63 |
| **Adjusted $R^2$** | 0.54 |
| **SE** | 0.1860 |

| Term | Coefficient | SE | p | 95% CI of Coefficient |
|---|---|---|---|---|
| **Intercept** | 0.1601 | 0.2531 | 0.5615 | -0.5428to 0.8629 |
| **Slope** | 0.0124 | 0.0048 | 0.0599 | -0.0008to 0.0256 |

| Source of variation | SSq | DF | MSq | F | p |
|---|---|---|---|---|---|
| **Due to regression** | 0.234 | 1 | 0.234 | 6.77 | 0.0599 |
| **About regression** | 0.138 | 4 | 0.035 | | |
| **Total** | 0.373 | 5 | | | |



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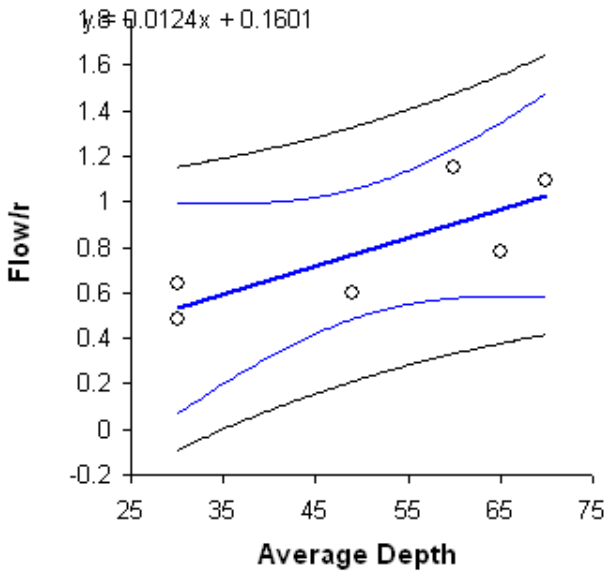


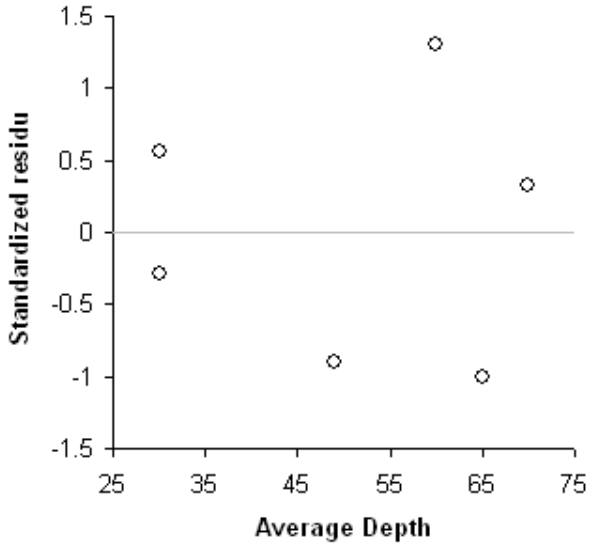


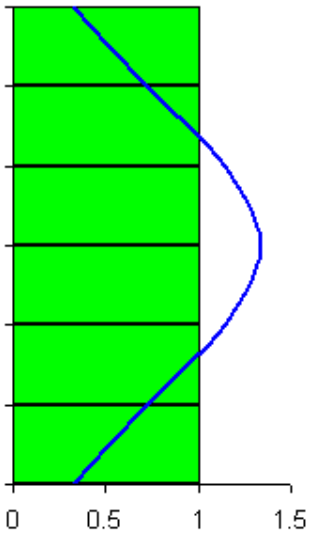


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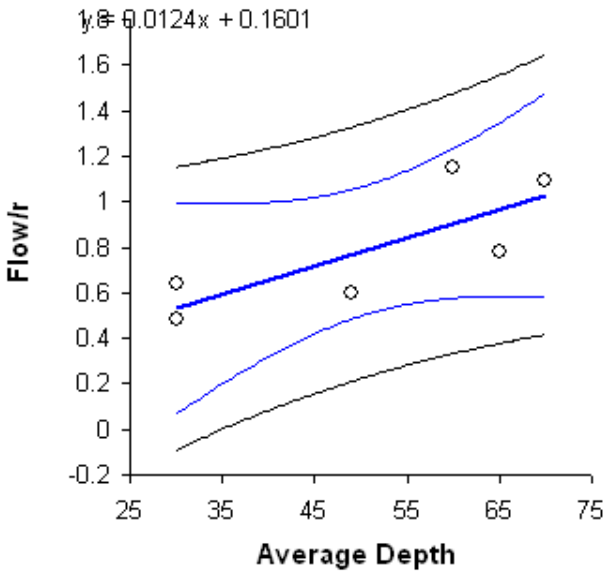
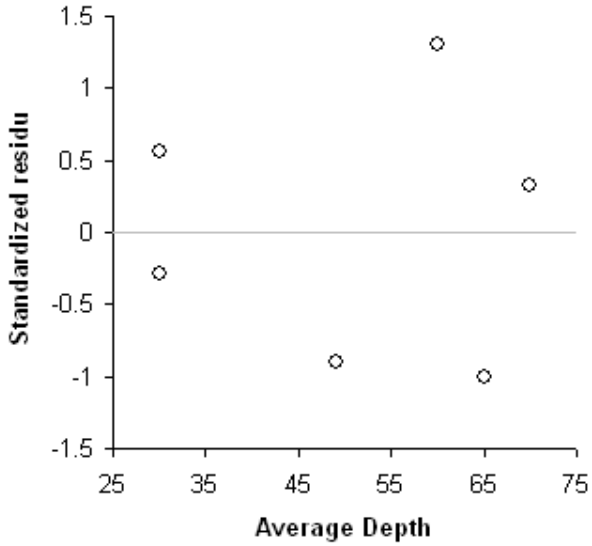
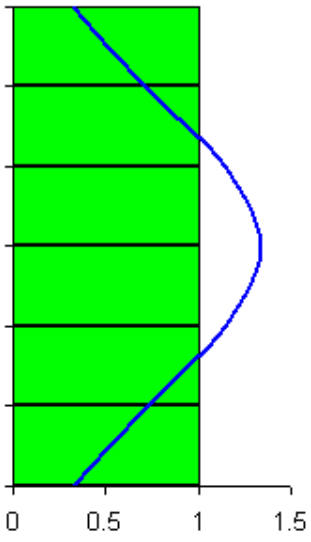
cmconsult@gmail.com
Mobile 0418938223

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C Muller Consulting
**ABN 63 195 874 227**
cmconsult@gmail.com
Mobile 0418938223

# Appendix B

# Summary of Changes to Stages A and B

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# Project Summary Document

## Background

Fortescue Metals Group Limited (FMG) is proposing to develop the Pilbara Iron Ore and Infrastructure Project (the Project) in the northwest of Western Australia. This Project includes the development of port facilities in Port Hedland and rail infrastructure to connect with a number of iron ore mines in the East Pilbara. FMG has been developing this Project over the past two years and has undertaken a number of studies regarding the environmental aspects potentially impacted by the Project. This has resulted in a number of revisions of the scope of the Project.

The purpose of this document is to outline the variations to the Pilbara Iron Ore and Infrastructure Project since it was released for public comment. It covers all three environmental impact assessments (EIA) released by FMG as part of requirements under the *Environmental Protection Act 1986* (EP Act):

- Stage A Port and North-South Railway: Public Environmental Review September 2004;
- Stage B East-West Railway and Mine Sites: Public Environmental Review January 2005;
- Cloud Break: Public Environmental Review September 2005.

## Introduction

FMG's Pilbara Iron Ore and Infrastructure Project (the Project) incorporates: port facilities at Anderson Point in Port Hedland, a railway stretching south-southeast to resources in the East Pilbara, and the development of iron ore mines in the Chichester and Hamersley Ranges.

For the purposes of environmental assessment and timing of development, the Project was separated into two stages. Stage A consists of port facilities at Anderson Point in Port Hedland and a 345 km railway extending south-southeast from the port. The Stage B proposal was for the development of four iron ore mines in the Pilbara and a 160 km east – west rail spur to connect three of these mines to the Stage A railway. As a result of FMG's ongoing exploration program

a further iron ore mine, Cloud Break, has since been referred to the Environmental Protection Authority (EPA) for assessment under the EP Act.

**Table 1: Summary of Environmental Impact Assessment Key Dates.**

| | **Referred to EPA** | **PER Public Comment Period** | **EPA Report and Recommendations** | **Ministerial Conditions Released** |
|---|---|---|---|---|
| **Stage A** | December 2003 | 20 September – 15 November 2004 | May 2005 | October 2005 |
| **Stage B** | March 2004 | 17 January – 14 March 2005 | October 2005 | December 2005 |
| **Cloud Break (Beneficiation)** | April 2005 | WITHDRAWN | | |
| **Cloud Break (no Beneficiation)** | June 2005 | 12 September – 24 October 2005 | January 2006 | |

The EPA determined that all three Projects should be assessed as Public Environmental Reviews (PER).

The Stage A project has the following main components: rail and port facilities consisting of rail loop, car dumper, stockyard and ore handling facilities with two stackers and a single reclaimer, re-screening facility, and product conveyor out to a wharf and ship loader.

The mining operations to be assessed in the Stage B proposal were Mt Nicholas, Mt Lewin, Christmas Creek located along the proposed Stage B rail spur and Mindy Mindy located at the southern end of the Stage A railway. In addition to mines and rail, the Stage B proposal also involved assessment of a bore field near Mt Lewin and a beneficiation plant located at the Christmas Creek mine.

The Cloud Break deposit was discovered later than FMG's other mineral deposits and was therefore referred to the EPA as a separate assessment early in 2005.

Initially, Cloud Break was assessed as a PER with an eight week public comment period. FMG revised the scope of the Project to utilise infrastructure that would be developed at Christmas Creek and resubmitted the proposal to the EPA.

The Cloud Break proposal consists of a number of iron ore pits located between the foot slopes of the Chichester Ranges and the Fortescue Marshes. Processing materials and infrastructure required at the mine will include crushing and screening machinery, accommodation and administration facilities, and ancillary equipment such as fuel trucks, water carts and large dozers. Ore requiring beneficiation will be transported to the Stage B beneficiation plant at Christmas Creek for processing prior to transfer to the port in Port Hedland. Transport of the ore will be via the railway that is proposed as part of the Stage B assessment.

**Project Variations**

As part of the EIA process, the documents prepared by FMG are publicly reviewed. In addition to this public review, FMG has also conducted additional studies, revised timelines, and undertaken further project refinements. In responding to the public reviews the EPA encourages proponents to clarify, review, or modify aspects of the proposal to address environmental issues or meet the objectives of the EPA.

With all major projects, proponents are required to notify the EPA of any variations to their project. On the advice of the EPA FMG will be managing changes to the project in the following ways. FMG will be submitting an application for project changes to Stage A under section 45c of the EP Act in the near future. Project revisions that were identified for the Stage B project were incorporated into the response to submissions document. However, in order to address questions raised during the public comment period of the Cloud Break assessment, this document has been prepared to outline the present format of the Pilbara Iron Ore and Infrastructure Project. For ease of reference this document shall be split to describe the changes in Stage A, Stage B, the Cloud Break characteristics and the overall effect of the changes.

*Stage A: North – South Rail and Port Facilities*

The original proposal presented in the Stage A PER involved the development of a 345 km rail line and Port facilities for the export of 45 Mtpa of iron ore. Changes to the proposal have included a shortening of the rail line, and a change in layout of the Port facilities. Table 2 outlines the original and amended characteristics of the Stage A proposal. FMG believes that these changes are not significant in an environmental context.

The initial proposed rail line was to extend from the port facilities in Port Hedland to the proposed mine at Mindy Mindy in the East Pilbara. In the amendment to Stage A the rail will be shortened by 155 km by removing the Chichester to Mindy Mindy section. The transport of ore from the Mindy Mindy mine will predominantly rely on the outcome of the current legal case to declare the BHP line with the National Competition Council. A draft declaration in FMG's favour was handed down in early November. By removing this section of rail from the Stage A proposal, FMG will reduce the clearing impacts from the North-South rail line from 3,100 ha during construction (1,500 ha during operation) to 2,385 ha during construction (1,120 ha during operation).

The proposed changes to the Port include the quantity of material to be dredged in the construction of the berthing areas at the wharf and the location of the rail loop. Following advice from the Port Hedland Port Authority (PHPA) and their pilots , the dredge volumes have changed from 3.3 $Mm^3$ to 4.5 - 5 $Mm^3$ . This allows for a conservative engineering buffer of 10%. The increase is required to address the PHPA requirement for a larger turning circle for ships to safely negotiate the port. The muds affected by this dredge have been demonstrated not to have acid generating capacity (URS 2005). Potential impacts from increased dredging will be turbidity and the disposal of the dredge material.

Turbidity modelling carried out by Worley (Appendix B1) has demonstrated that the effect of this increase will be insignificant, however FMG will monitor turbidity during dredging. FMG has commissioned URS to assist in developing an environmental management strategy for the port. This will include a harbour turbidity monitoring program and trigger levels, that will allow for any adverse impacts from turbidity dredging to be identified and effectively managed. The increase in dredge material is not expected to affect the management strategy.

Disposal of the dredge material will be as described in Stage A PER (Section 4.3.4). It is FMG's desire that ocean disposal of dredge spoil be avoided where-ever possible. With this in mind, the revised proposal increases the bunded reclamation area of the port by 81 ha to hold the increased dredge material. The area of increase is classified as supratidal and the vegetation is considered of low conservation significance (Biota 2004).

The amendment to Stage A also includes moving the rail loop from the location assessed by the EPA (Figure 1a) east to locate it on the reclamation area around the stockpiles (Figure 1b). Firstly, the relocated port rail loop will reduce the overall footprint during operations. Secondly, the vegetation types impacted by the original rail loop location included areas of closed canopy mangroves. By relocating the rail loop to the proposed location FMG will reduce the amount of closed canopy mangrove directly impacted by the development. Finally, the loop relocation will significantly reduce the potential risk to the South-West Creek ecology from the rail formation.

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Finucane Island
Spoil Bank
Cook Point
Salmon Creek
Laurentius Point
Mangrove Point
Harriet Point
Nelson Point
Stanley point
Ship Loading Facilities
Owen Point
Anderson Point
Bund for Dredge Spoil
Smith Point
Lumsden Point
Stingray Creek
Pretty Pool
South East Creek
South West Creek
PROPOSED HOPE DOWNS IRON ORE PORT PROJECT AREA
Loadout Conveyor
Car Dumper
Conveyor
FMG Iron Ore Stockpile
Screen House
Dredge Spoil Reclamation Area
Bund for Dredge Spoil
FMG Unloading Loop
BHPB - Port Hedland Shay Gap Railway
Crossing
Wedgefield
Proposed FMG Port Facilities
N
0
1
2
kilometers

# Fortescue Metals Group Limited.

## Figure 1a
## Original Port Layout

| | |
|---|---|
| Author: A. Gregory | Date: 06/04/2004 |
| Drawn: FMG | Revised: 10/11/2005 |
| Dwg No.: FMG 04037l | Report No.: |
| Projection.: GDA94 zone 50 | Scale: 1 : 50 000 |

FMG 04037l

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- Reclaim Area
- Stock pile area
- Future stock pile area
- Rail line/loop
- BHP Rail line
- Conveyer

N

0 250 500 1000

metres

**Fortescue Metals Group Limited**

## Figure 1b
## Amended Port Layout

| | |
|---|---|
| Author: Enviro | Date: 14 Oct 2005 |
| Drawn: Jen Thomson | Revised: 10 Nov 2005 |
| Dwg No.: 05_177_1110_ENV | Report No.: |
| Projection: GDA94 Zone 50 | Scale: 1:25,000 |

**Table 2: Stage A Summary of Key Project Characteristics (Original and Amended)**

| Element | Original | Amended |
|---|---|---|
| General | | |
| Construction Period | 20 months approximately | no change |
| Project Life | 20+ years | |
| Export Tonnage | 45 Mtpa | |
| Railway | | |
| Length | • 345 km approximately | • 190 km approximately |
| Support Infrastructure | • Sidings | • no change |
| | • Administration offices and warehouses | • no change |
| | • Trip servicing facilities | • no change |
| | • Service and repair workshop | • no change |
| | • Rail loops and marshalling yards | • no change |
| | • Maintenance facilities | • no change |
| | • Substations | • no change |
| | • Communication systems | • no change |
| Port | | |
| Stockyard | • 2.5 Mt capacity (live) | • no change |
| Materials Handling | • Car dumper | • no change |
| | • Conveyors and transfer points | • no change |
| | • Rescreening plant | • no change |
| | • 2 x Stackers (8,000 tph each) | • 2 x Stackers (11,080 tph each) |
| | • Reclaimer (10,000 tph) | • Reclaimer (12,500 tph) |
| Port Development | • Single wharf 750 m long | • no change |
| | • Parking berth | • no change |
| | • Ships up to 250,000 DWT | • no change |
| | • Shiploader (10,000 tph) | • Shiploader (12,500 tph) |
| | • Dredging – 3.3 $Mm^3$ | • Dredging – 5 $Mm^3$ |
| Buildings | • Shift office | • no change |
| | • Control room and amenities | • no change |
| | • Wharf amenities | • no change |
| | • Substations | • no change |

| | | |
|---|---|---|
| **Infrastructure** | | |
| Power<br>Water<br>Fuel<br>Roads<br>Sewerage | 17.5 MW from existing system<br>2.0 GLpa from existing system<br>45 MLpa for locomotives and other vehicles<br>General traffic, port access, rail service<br>Construction – package treatment plant<br>Operations – septic systems | no change |
| **Disturbance Areas*** | | |
| • Area of railway construction<br>– (Railway construction corridor)<br>– (Access track, yards, temporary disturbance)<br>• Area of port facilities construction (including spoil reclamation below proposed stockpiles and temporary disturbance areas)<br>• Total area disturbed during construction<br>• Area of operating railway<br>– (Railway corridor)<br>– (Access road, yards, workshops, maintenance areas)<br>• Area of operating port facilities (including stockpile areas and conveyors)<br>• Total operational areas | 3,100 ha<br>(1,500 ha)<br>(1,600 ha)<br><br>300 ha<br><br><br>3,400 ha<br>1,500 ha<br>(688 ha)<br>(812 ha)<br><br>100 ha<br><br>1,600 ha | 2,385 ha<br>(1,115 ha)<br>(1,270 ha)<br><br>381 ha<br><br><br>2,766 ha<br>1,120 ha<br>(488 ha)<br>(632 ha)<br><br>100 ha<br><br>1,220 ha |
| **Workforce (approximate peak levels)** | | |
| Construction<br><br>Operations<br>Accommodation | Rail – 1,000 personnel<br>Port – 500 personnel<br>Port and Rail – 225 personnel<br>Construction – single status in Port Hedland<br>Track camps for rail<br>Permanent – new or existing residences in Port Hedland, Newman or permanent rail camp | no change |

**Key:**

| | |
|---|---|
| * | includes a contingency |
| Mtpa | Million tonnes per annum |
| tph | tonnes per hour |
| m | metres |
| DWT | dead weight tonne |
| $Mm^3$ | Million cubic metres |
| MW | mega watts |
| GLpa | giga litres per annum |
| MLpa | million litres per annum |
| Mt | million tonnes |
| ha | hectare |
| km | kilometres |

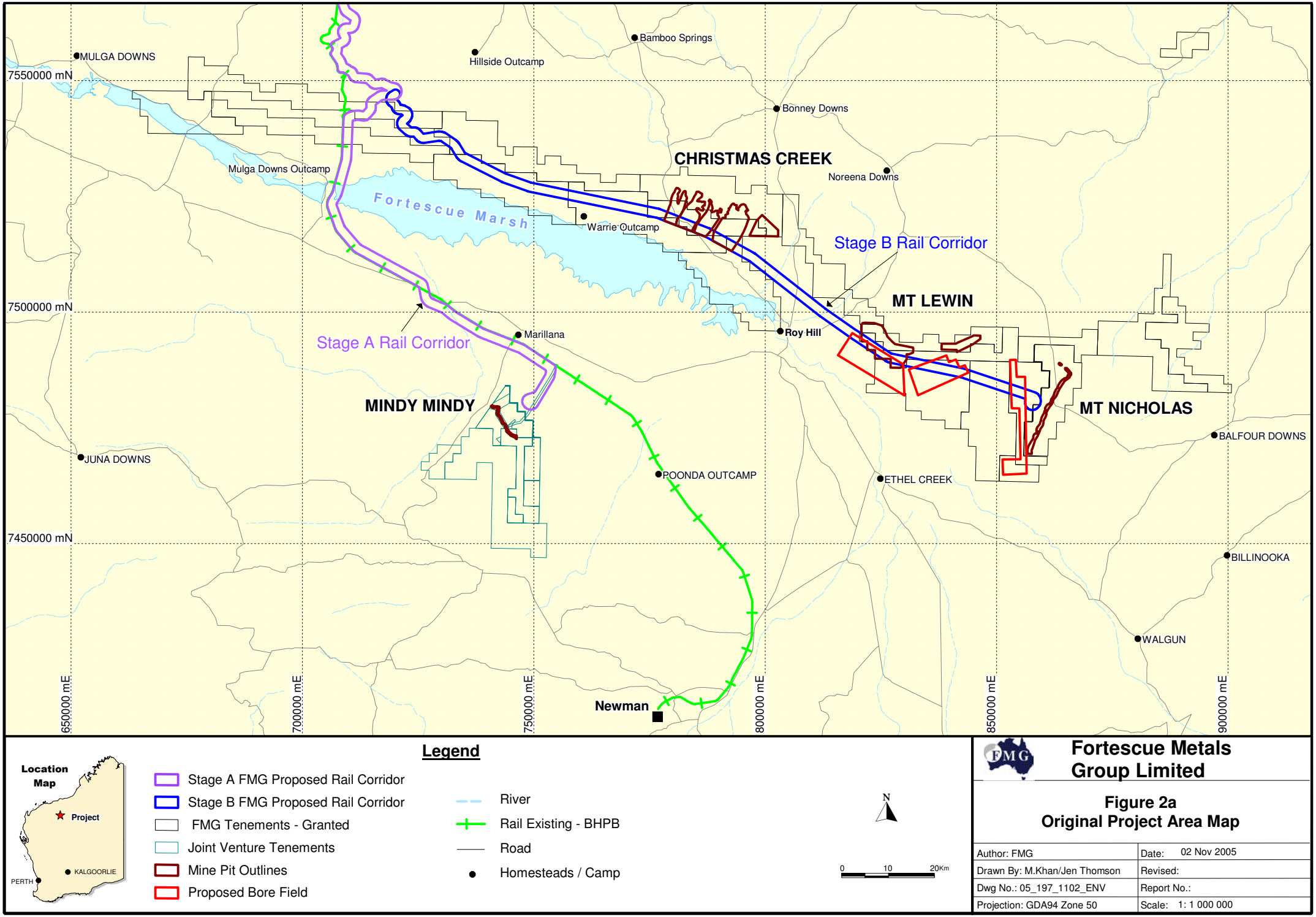
*Stage B: Mines and East – West Rail*

Table 3 outlines the original and amended components of the Stage B proposal. Project variations for Stage B were incorporated into the Response to Submissions document at the request of the EPA. As with the proposed changes for Stage A, it is FMG's belief that the changes to the Stage B project will not result in an effect on the environment in addition to, or different from, the effect of the original proposal. Variations to the Project include; the length of rail; alignment of the rail, and the number of proposed mine sites. The variations to the Stage B proposal are partially a result of further exploration activity resulting in the identification of the Cloud Break deposit.

The initial rail line proposed in the Stage B PER extended from the North–South rail on the southern side of the Chichester Ranges eastwards to link FMG's resources to the port infrastructure (Figure 2a). The length of this rail was 160 km with a proposed disturbance area of 1,600 ha during construction which would reduce to 800 ha for operation. Areas disturbed during construction but not required for ongoing operation would be rehabilitated on completion of construction activities. With the revision of mining activities and the reduction of the North–South rail, a new alignment through the Chichester Ranges was sought. The East–West rail alignment now crosses the Chichester Ranges further east than the original proposal before dipping down to the Cloud Break mine and terminates at the Christmas Creek mine (Figure 2b). This has resulted in a reduction of the length of the rail by 49 km and a reduction in the disturbance figures for construction to 1,200 ha and the ongoing operating disturbance to 600 ha.

The location and alignment of the proposed East–West rail is important to allow FMG to access its resources, for transportation of these resources to port, and also to ensure that any potential environmental impacts are considered and managed. Due to the occurrence of sheet flow and its importance to stands of Mulga in the vicinity of the Project area, the alignment of the rail needs to be considered carefully. The original route referred to in the PER document would result in the clearing of 306 ha of Mulga vegetation. The revised preferred rail alignment will impact on 125 ha of Mulga vegetation.

The revisions to the Stage B proposal will also see a reduction in the overall area of disturbance from the removal of the Mt Lewin and Mt Nicholas mines. The




# Fortescue Metals Group Limited

## Figure 2a
## Original Project Area Map

| | |
|---|---|
| Author: FMG | Date: 02 Nov 2005 |
| Drawn By: M.Khan/Jen Thomson | Revised: |
| Dwg No.: 05_197_1102_ENV | Report No.: |
| Projection: GDA94 Zone 50 | Scale: 1: 1 000 000 |

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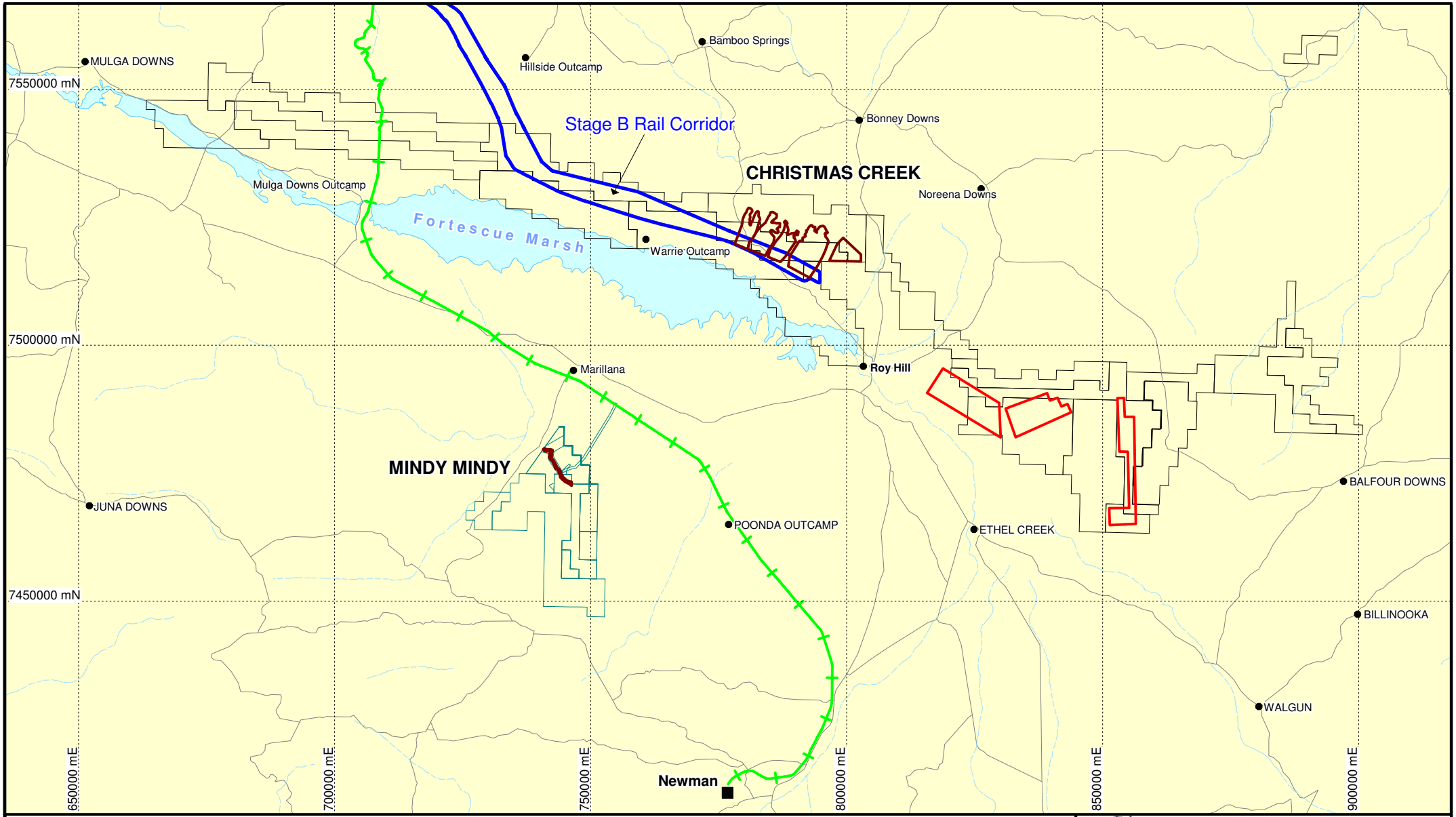



## Legend

- Stage B FMG Proposed Rail Corridor
- FMG Tenements - Granted
- Joint Venture Tenements
- Mine Pit Outlines
- Proposed Bore Field
- River
- Rail Existing - BHPB
- Road
- Homesteads / Camp

N

0 10 20Km

**Fortescue Metals Group Limited**

**Figure 2b**
**Revised Stage B Layout**

| | |
|---|---|
| Author: FMG | Date: 02 Nov 2005 |
| Drawn By: M.Khan/Jen Thomson | Revised: |
| Dwg No.: 05_197_1102_ENV_L2 | Report No.: |
| Projection: GDA94 Zone 50 | Scale: 1: 1 000 000 |

initial area of disturbance for Stage B was 17,107 ha, including 15,507 ha for mine disturbance and 1,600 ha for rail disturbance. With the removal of the Mt Lewin and Mt Nicholas mines and the realignment of the railway, the overall disturbance has reduced to 12,175 ha encompassing 10,975 ha for mines and 1,200 ha for rail. All infrastructure requirements for Mt Nicholas and Mt Lewin have also been removed from the Stage B Project.

The water requirements of ore beneficiation at Christmas Creek have now been reduced from 11 GLpa to approximately 8 GLpa. This is because high grade ore that was to be treated at the beneficiation plant will now be dry crushed and screened before direct shipping ("direct shipping" is the term used to indicate that ore is deemed to be able to be shipped to a buyer without prior beneficiation). Additionally, the amount of pit dewatering from Cloud Break (an approximate average of 5,329 MLpa) more than offsets the pit dewatering volumes that would have been sourced from Mt Lewin (520 MLpa) and Mt Nicholas (2,850 MLpa). Cloud Break dewatering will be stored in storage ponds constructed in three pit areas at the eastern end of Cloud Break for the first six years of mine operation, before being pumped to Christmas Creek to be used in the beneficiation plant. Dewatering from Cloud Break will also be used for onsite applications including dust suppression and general potable uses. The water requirements of beneficiation can be accommodated between pit dewatering at Christmas Creek and Cloud Break and the Mt Lewin bore field which was assessed as part of the Stage B proposal.

As mentioned above, there is expected to be a decrease in the volumes of ore that are being proposed to be processed through the Christmas Creek beneficiation plant. Mining at Christmas Creek is planned to commence in Year 7. 15 Mt of ore from Christmas Creek will require beneficiation in Year 7 and 30 Mtpa in Years 8-20.

**Table 3: Stage B Summary of Key Characteristics (Original and Amended).**

| Element | Original | Amended |
|---|---|---|
| ***Mining*** | | |
| Location | Mindy Mindy mine (approximately 70km north of Newman),<br>Christmas Creek, Mt Lewin and Mt Nicholas mines (approximately 100km north of Newman) | Mindy Mindy mine (approximately 70km north of Newman) and<br>Christmas Creek mine (approximately 100km north of Newman) |
| Activities | Iron ore strip mining, pit backfilling, ore crushing, beneficiation, mine rehabilitation and closure | No change |
| Resource | Mindy Mindy: 68 Mt channel iron deposit, 40m average pit depth;<br>Christmas Creek: 1000 Mt Marra Mamba ore, 60m average pit depth<br>Mt Nicholas: 390 Mt Marra Mamba ore, 60m average pit depth<br>Mt Lewin: 200 Mt Marra Mamba ore, 50m | Mindy Mindy: 68 Mt channel iron deposit, 40m average pit depth;<br>Christmas Creek: 1000 Mt Marra Mamba ore, 60m average pit depth |
| Rate of production | Combined 45 Mtpa | No change |
| Duration | 20+ years | No change |
| Mine site infrastructure<br>Christmas Creek, Mt Lewin, and Mt Nicholas | • Semi-mobile primary crusher<br>• Overland conveyors, haul road and/or rail to Beneficiation Plant<br>• Haul roads and access tracks<br>• Secondary crushers, screening plant and Beneficiation Plant<br>• Iron ore product stockpile and train loading facilities<br>• Mobile plant and machinery workshop<br>• Bulk hydrocarbon storage facility<br>• Explosive and detonator and magazines<br>• Construction of 132 kV transmission line to Newman with capacity upgrade at Newman OR<br>• 45 MW power station (to be provided and maintained by an external supplier)<br>• Accommodation and camp facilities<br>• Administration and ancillary support facilities | Infrastructure only to be constructed at Christmas Creek |

| Element | Original | Amended |
|---|---|---|
| | • Airstrip upgrade at Christmas Creek<br>• Concrete batching plant (during construction) | |
| Mindy Mindy | • Crushing and screening plant<br>• Sealed haul road or overland conveyor system from crushing/screening plant to rail loading facility<br>• Administrative and maintenance hub<br>• Iron ore product stockpiles and train loading facility<br>• Mine dewatering pumps and pipeline<br>• Airstrip upgrade at Mindy Mindy<br>• Accommodation village<br>• 4 MW power station (to be provided and maintained by an external supplier) OR<br>• Connection to 132 kV Newman-Yandi transmission line. | No change |
| Area of mine disturbance* | Mindy Mindy: 852 ha disturbed and rehabilitated over LOM<br>Christmas Creek: 10,123 ha disturbed and rehabilitated over LOM<br>Mt Lewin: 1,775 ha disturbed and rehabilitated over LOM<br>Mt Nicholas: 2,757 ha disturbed and rehabilitated over LOM | Mindy Mindy: 852 ha disturbed and rehabilitated over LOM<br>Christmas Creek: 10,123 ha disturbed and rehabilitated over LOM |
| ***Beneficiation Plant*** | | |
| Location | Christmas Creek, Mt Nicholas | Christmas Creek |
| Commencement | Year 1 | Year 7 |
| Production capacity | 45 Mtpa | 15 Mtpa Year 7<br>30 Mtpa Years 8-20 |
| ***Railway Infrastructure*** | | |
| Railway Infrastructure | • 160 km of rail track<br>• Sidings, passing bays and loading loops<br>• Train loader<br>• Rail maintenance track<br>• Temporary construction facilities | • 111 km of rail track<br>• No change<br>• No change<br>• No change<br>• No change |

| Element | Original | Amended |
|---|---|---|
| Area of railway disturbance*<br>Railway operations | • 1,600 ha<br>• 800 ha | • 1,200 ha<br>• 600 ha |
| ***General*** | | |
| Employment | 800 personnel for construction on-site;<br>500 personnel divided between on-site and local towns mainly Newman) for the operational stage | No change |
| Water requirements | 11.4 GLpa / 31.2 Megalitres per day to be supplied from dewatering and borefield to be developed | 8.2 GLpa / 22.5 Megalitres per day to be supplied from dewatering and bore field to be developed. |
| Power supply | To be provided and maintained by an external supplier | No change |

**Key:**

| | |
|---|---|
| * | includes a contingency |
| Mtpa | Million tonnes per annum |
| m | metres |
| km | kilometres |
| Ha | hectare |
| MW | mega watts |
| GLpa | giga litres per annum |
| Mt | million tonnes |
| km | kilometres |
| LOM | Life of Mine |

*Cloud Break Iron Ore Mine*

As stated earlier, the Cloud Break Iron Ore mine was identified later in the exploration program and therefore was unable to be incorporated into the Stage B assessment. Table 4 outlines the key characteristics of the Cloud Break proposal. Table 5 shows the scope of the key characteristics of the Stage B and Cloud Break proposal as they have been presented to the EPA.

Cloud Break mine will produce both low grade (58% iron) and high grade ore (60-61% iron). Traditionally low grade ore is beneficiated to increase the iron concentration to 60% or more. However, as a result of the demand in the iron ore market, FMG have identified a market for low grade ore. Therefore, Cloud Break ore will no longer require beneficiation as it will be dry crushed and screened before direct shipping. This will reduce the water requirements for the beneficiation plant.

Dewatering water from Cloud Break is proposed to be stored in the first six years of mine operation before being pumped to Christmas Creek to be used in the beneficiation plant. As described in the PER, Aquaterra conducted comprehensive studies and modelling that indicate that the quality of dewatering water is likely to be 3,000 – 6,000 mg/L salinity. FMG is currently conducting further studies to determine the management measures required to minimise any impacts of the storage of this water on birdlife and neighbouring aquifers. Aquaterra will liaise closely with DoE and CALM to ensure that they are satisfied with dewatering disposal methods.

**Table 4: Cloud Break Summary of Key Characteristics**

| Project Component | Characteristic |
|---|---|
| Construction period | 6-12 months, commencing in Q1 2006 |
| Project Life | 12 years |
| Export tonnage | 10-30 Mtpa |
| ***Mining*** | |
| Estimated Resource | 500-600 Mt |
| Ore type | Marra Mamba |
| Target grade | ~ 60% Fe |
| Method of mining | Open pit with back filling as far as practicable |
| Total area of disturbance over LOM* | 5,500 ha |
| Total area of rehabilitation over LOM | 5,500 ha |
| Average size of working open pit | 475 ha |
| Average pit depth | Ranges from 0 to 70 m based on current exploration results |
| Stripping ratio | Average 4:1 over LOM |
| Overburden produced | 1,275 Mt over LOM (340 MT in external areas: remainder placed in pit) |
| Processing requirements | Direct Shipped Ore – no beneficiation required |
| Dewatering requirements | Dewatering (averaging approximately 5,329 MLpa) will produce excess water which will be temporarily stored in ponds located in an area earmarked for mining for the first six years. The water will then be transported to Christmas Creek for use in the beneficiation plant |
| ***Infrastructure*** | |
| Power | Provided and maintained by third party supplier |
| Water | Water will be required for dust suppression and general potable uses. This will be sourced from dewatering of the pits. A Reverse Osmosis (RO) plant may be required if dewatering water is not of sufficient quality for potable use. The saline waste water from the RO plant will be disposed of in the dewatering storage pond |
| Sewage | Package treatment and/or septic systems |
| ***Workforce (approximate peak levels)*** | |
| Construction | 400 |
| Permanent | 400 |
| Accommodation | Construction personnel accommodated in on-site facilities. Operational personnel accommodated in on-site facilities and in Newman |

**Key:**

| | | | |
|---|---|---|---|
| * | includes a contingency | km | kilometres |
| Mtpa | Million tonnes per annum | Ha | hectare |
| m | metres | LOM | Life of Mine |
| Mt | million tonnes | | |

**Table 5: Key Characteristics of FMG's Mining Operations (As amended).**

| Project Component | Characteristics Cloud Break | Characteristics Christmas Creek | Characteristics Mindy Mindy |
|---|---|---|---|
| Construction period | 6-12 months, commencing Q1 in 2006 | | |
| Project life | 12 years | 20 years | |
| Export tonnage | 10 - 30 Mtpa | 10 - 45 Mtpa | |
| ***Mining*** | | | |
| Estimated resource | 500-600 Mt | 1 000 Mt | 68 Mt |
| Ore type | Marra Mamba Iron Ore | | Channel Iron |
| Target grade | ~60% Fe | 55 -65% Fe | |
| Method of mining | Open pit with back filling as far as practicable | Open pit with back filling as far as practicable | |
| Total area of disturbance over LOM | 5,500 ha | 10 123 ha | 852 ha |
| Total area of rehabilitation over LOM | 5,500 ha | 10 123 ha | 852 ha |
| Average size of working open pit | 475 ha | 450 ha | 65 ha |
| Average pit depth | Ranges from 0 m to 70 m based on current exploration results | 60 m | 40 m |
| Stripping ratio | Average 4:1 over LOM | Average 5:1 over LOM | Average 5:1 over LOM |
| Overburden produced | 1,275 Mt over LOM (340 Mt in external areas; remainder placed in pit) | 112 Mtpa deposited to an overburden placement area in first 2 years (388 ha) after which used to progressively backfill strip mining operations. | 20 Mtpa deposited to an overburden placement area in first 2 years (200 ha) after which used to progressively backfill strip mining operations. |
| Processing requirements | DSO, crushed and screened at Cloud Break | Beneficiation and DSO, crushed and screened at Christmas Creek | DSO, crushed and screened at Mindy Mindy |
| Dewatering requirements | Dewatering averaging approximately 5,329 MLpa) will produce excess water which will be temporarily stored in ponds located in an area earmarked for mining for the first six years. The water will then be transported to Christmas Creek for use in the beneficiation plant | 1.15 GLpa dewatering will be pumped for use in the beneficiation plant. | 0.4 GLpa dewatering |
| ***Infrastructure*** | | | |
| Power | 45 MW power station provided and maintained by third party supplier | | 4 MW power station (to be provided and maintained by an external supplier) or |

| Project Component | Characteristics Cloud Break | Characteristics Christmas Creek | Characteristics Mindy Mindy |
|---|---|---|---|
| | | | connection to 132 kV Newman-Yandi Transmission line. |
| Water | Water will be required for dust suppression and general potable uses. This will be sourced from either dewatering of the pits or from nearby alluvial deposits. A Reverse Osmosis (RO) plant may be required if dewatering water is not of sufficient quality for potable use. The saline waste water from the RO plant will be disposed of in the dewatering storage pond. | | |
| Roads | Haul roads and service roads required to link mine to crushing plant and rail loadout | Haul roads and service roads required to link mine to crushing plant and rail loadout | Haul roads and service roads to link to rail (pursuing access to existing rail infrastructure) |
| Sewage | Package treatment and/or septic systems | | |
| ***Workforce (approximate peak levels)*** | | | |
| Construction | 400 | 400 | |
| Permanent | 400 | 400 | |
| Accommodation | Construction personnel accommodated in on-site facilities. Operational personnel accommodated in on-site facilities and in Newman | Construction personnel accommodated in on-site facilities. Operational personnel accommodated in on-site facilities and in Newman | |

*Key:*

*DSO – Direct Shipped Ore*
*Fe - iron*
*ha – hectare*
*LOM – Life of Mine*
*m – metre*
*Mtpa – million tonnes per annum*
*Mt – million tonnes*
*m – metre*
*Mtpa – million tonnes per annum*
*Mt – million tonnes*

*Cumulative Information*

Water Requirements

Total operating water requirements from the Pilbara Iron Ore and Infrastructure Project over its life will reduce from 13 GLpa to 10 GLpa.

Water requirements of Stage A operations are unchanged from those described in Section 7.3.2.1 of the Stage A PER, that is 2 GLpa.

The information in Table 5 shows that FMG still intends to mine a cumulative total of 45 Mtpa from the Mindy Mindy, Christmas Creek and Cloud Break mines. Current proposed production levels will be maintained. The identification of a market for high value ore that doesn't need beneficiation means that there will be reduced water requirements for the Project as a whole. The Stage B water requirement was estimated to be 11 GLpa. This is reduced to 8 GLpa and also includes the Cloud Break mine.

Additional to reduced water requirements during operations, less water will be needed for railway construction. Railway construction is estimated to require 1 ML water per day. The length of rail in Stage A is now reduced by approximately 45% and the length for Stage B is reduced by approximately 25%. Therefore water use for rail construction is conservatively estimated to be reduced by 30%.

Clearing Disturbance

There is no increase in clearing disturbance created by the addition of Cloud Break mine. In fact, the amendments to Stages A and B, coupled with the inclusion of Cloud Break reduce clearing for the Pilbara Iron Ore and Infrastructure Project from 20 507 ha to 20 441 ha.

The changes in the port layout and reduction of the North-South rail length results in the operational area of disturbance associated with Stage A reducing from 1,600 ha to 1,220 ha. For Stage B, with the removal of Mt Lewin and Mt Nicholas mines and reduction of the East-West rail length, the area of clearing is significantly reduced from 15,507 ha to 12,175 ha. Clearing for Cloud Break will be 5,500 ha. Based on these figures, the cumulative area of disturbance for Stages A, B and Cloud Break is 18,895 ha.

In addition to reducing the area of clearing, the alignment change of the East-West rail route reduces disturbance to Mulga vegetation from 306 ha to 125 ha. By relocating the East-West rail alignment further north than originally proposed in the Stage B PER, FMG believes that indirect impacts from sheet flow interruption are also significantly reduced.

Threatened Flora and Fauna

There are no changes to the impacts on Threatened Flora or Fauna from those already described in the PERs.

Fortescue Marshes

The proposed Stage B and Cloud Break mining areas are located within the upper Fortescue River catchment. Total clearing within the Fortescue River catchment will reduce as a result of the project changes. Runoff from this catchment drains to the Fortescue Marshes which form an extensive intermittent wetland. The main potential impacts from the proposed mine developments on this catchment would be a potential reduction of surface water runoff volume and water quality in the downstream environment.

The cumulative impacts assessed during the development of the Cloud Break PER are representative of the amended Project. The potential surface water impacts from the Project are presented in the Cloud Break PER Appendix B and summarised in Section 6.5. When considering all of FMG's Project Areas within the catchment, the total area of disturbance over the life of the two Projects (20 years) will be approximately 16,200 ha. However, these areas will be progressively rehabilitated and not all subjected to disturbance at one time. The maximum area of working pits at Cloud Break at one time is expected to be 475 ha, and the maximum area of working pits for the Stage B Project at any one time is expected to be 450 ha. If a conservative estimate is made that one quarter of the proposed mining area for both Projects will be active at any one time, then this represents 0.1% of the upper Fortescue River catchment.

Any surface water runoff from pit areas, overburden placement areas, and plant areas will be treated via sedimentation basins prior to release to the downstream environment. Any area where potential polluting substances (e.g. hydrocarbons) are stored or handled will be bunded and internal drainage collected, treated and used on-site. Provided the proposed management measures outlined in Section 6.5 or the Cloud Break PER are implemented, FMG considers there to be low potential impact on the quality of surface water runoff draining to the Fortescue Marshes.

Stygofauna

It is likely that stygofauna are present within the predicted groundwater drawdown zones at Cloud Break and the Stage B Project (See Cloud Break PER Section 4.6.3). However, stygofauna sampling completed in March 2005 for both Projects has indicated that none of the stygofauna species recorded within the dewatering drawdown area was considered of

significance or unique to the area. The two potentially new species of *Paramelitidae* identified from Cook Bore (which is outside the influence of the mine dewatering) have been identified in other Pilbara locations away from the Projects since the release of the PER, The June 2005 survey recorded two undescribed species of *Syncaridia* within the drawdown area at Mt Nicholas. However as discussed previously, Mt Nicholas will no longer be mined and therefore will no longer require dewatering.

FMG have developed a Stygofauna Management Plan as shown in Appendix K of the Cloud Break PER. The Management Plan includes a sampling program that has been implemented in consultation with CALM. Following further sampling results, FMG have committed to expanding and improving the sampling program, the results of which will continue to be made available to CALM. It is anticipated that 15 bores inside and outside the Project area would be added to the program in consultation with CALM.

Implementation of the Stygofauna Management Plan will ensure, the Projects do not adversely affect the conservation significance of any particular stygofauna that may be present within FMG's Project Areas.

Greenhouse Gas emissions

The Stage A railway south of the Chichester Ranges will not be constructed. The Stage B Project has also been revised so that mining at Mt Nicholas and Mt Lewin is no longer proposed and the railway east of Christmas Creek will not be constructed. These changes reduce the proposed area of clearing, and distances travelled by locomotives (and hence fuel consumption) and therefore reduce the potential greenhouse gas emissions. FMG have committed to developing and implementing a Greenhouse Gas Management Plan prior to commencement of construction.

Noise

The changes to the Stage A project have been incorporated in to noise re-modelling by Lloyd Acoustics (Appendix B2). The modelling shows a decrease in noise received in Port Hedland due to the removal of one ship loader. The relocation of the rail loop results in a 2-3 dB($L_{Aeq\ 8\ hour}$) increase in South Hedland – Parker Street (Lawson) and a 2 dB(A) increase at White Hills Rural Residential Area. Although rail noise is exempt from the *Environmental Protection (Noise) Regulations,* FMG have developed a Noise Management Plan that will be implemented to minimise the effects of the Project on noise-sensitive premises.

The cumulative operational noise impacts assessed during the development of the Cloud Break PER (Section 6.14.6) are representative of the amended Project. The results of the assessment are summarised in Table 7.

**Table 7. Predicted Night-time LAeq (8 hour) and LAmax Noise Levels from Trains**

| Receiver Location | Night Time $L_{Aeq\ (8\ hour)}$ Noise Level dB | $L_{Amax}$ Noise Level dB |
|---|---|---|
| Mine Camp | 38 | 47 |
| Fortescue Marshes | 39 | 44 |
| Bamboo Springs | 26 | 29 |
| Mulga Downs Outcamp | 25 | 32 |
| Warrie Outcamp (not residential) | 43 | 50 |

It should be noted that higher noise levels ($L_{Aeq\ (8\ hour)}$ 43 dB) are predicted at Warrie Outcamp, however, this is a remote camp and is not considered to be a residence.

Many of the studies on noise impacts on birds conducted to date are inconclusive. The animals initial reaction to a new noise source may be fright and avoidance, but if other sensory systems are not stimulated (sight and smell), the animal learns quite quickly to ignore the noise source.

FMG have committed to the development of a Noise and Vibration Management Plan and to monitor the effects of blasting on birds. It should be noted that the Marshes are 3 km from the closest pit, and many of the proposed mining areas are significantly further away than this.

## Conclusion

FMG's Pilbara Iron Ore and Infrastructure Project incorporates port facilities at Anderson Point in Port Hedland, a railway stretching south-southeast to resources in the East Pilbara, and the development of iron ore mines in the Chichester and Hamersley Ranges. These projects are in various stages of environmental assessment under the *Environmental Protection Act (1986)*. As planning for these projects has progressed, some changes have been made that have implications for the assessment process. This document summarises those changes and reviews the cumulative impacts of the project in its current form.

It is the view of FMG the environmental assessment process has adequately captured the project as currently proposed. Indeed, most project changes involve a reduction in the footprint of the operations from that originally proposed.

## References

Biota Environmental Sciences (2004) Flora and Vegetation Surveys for the Proposed FMG Port and Rail Corridor.

URS (2005). ASS Review and Recommendations (Rev 2), Pilbara Iron Ore and Infrastructure Project, Port Hedland.

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# Appendix B1

# Pilbara Iron Ore and Infrastructure Project – Dredging Effects Study

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Worley

Fortescue Metals Group Ltd

FORTESCUE METALS GROUP LTD

# Pilbara Iron Ore & Infrastructure Project

## Dredging Effects Study

300/10244/5130-CO-RP-0001

9-Nov-05

Level 6, QV1
250 St Georges Terrace
Perth, Western Australia 6000
Tel: +61 8 9278 8111
Fax: +61 8 9278 8110
Web: http://www.worley.com.au
Worley Pty Ltd
ABN 61 001 279 812



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PROJECT 300/10244/5130-CO-RP-0001 - PILBARA IRON ORE & INFRASTRUCTURE

| REV | DESCRIPTION | ORIG | REVIEW | WORLEY APPROVAL | DATE | CLIENT APPROVAL | DATE |
|---|---|---|---|---|---|---|---|
| A | Issued for internal review | J. Garcia-Webb | M. Burling | N/A | 1-Sep-05 | N/A | |
| B | Issued for internal review | J. Garcia-Webb | M. Burling | | 17-Oct-05 | | |
| C | Issued for client review | J. Garcia-Webb | M. Burling | W. Farrow | 9-Nov-05 | | |
| | | | | | | | |

# CONTENTS

## Appendices

# 1. INTRODUCTION

Fortescue Metals Group (FMG) plan to construct iron ore loading and berthing facilities at Port Hedland as part of their planned Pilbara Iron Ore and Infrastructure Project in Western Australia's Pilbara Region. The marine component will involve dredging in the existing harbour basin of the Port, and development of two berth pockets adjacent to Anderson Point.

The dredging material will be used to reclaim two areas, one at Anderson Point and one farther to the south. Figure 1-1 shows the proposed layout of the dredging and reclamation areas.

## 1.1 Scope of Works

WorleyParsons has been commissioned to assess the potential impacts due to the dispersion of suspended sediment produced by the dredging program. The dredging has the potential to generate suspended sediment at the cutter head, and from the tailwater disposal from the reclamation areas. Tidal and wind generated currents are then expected to transport the plume throughout and beyond the harbour. No offshore disposal of dredged material is proposed.

Coral bommies in the immediate coastal area, outside the existing harbour, have been identified as potentially sensitive to increases in suspended sediment concentration. These are identified in Figure 1-1 as sites WFO, EFO and PHO, and their locations shown in Table 1.1. There is also the potential for the mangrove systems within and adjacent to the harbour to be affected by the dredging plume. In addition, the dispersing fines could increase the siltation of the existing harbour and berth pocket areas.

**Table 1.1 Easting, northing coordinates of coral bommies**

| | Easting (m) | Northing (m) |
|---|---|---|
| **EFO** | 664219 | 7755036 |
| **WFO** | 660041 | 7754254 |
| **PHO** | 670544 | 7755106 |

To assess these potential impacts, a high resolution model of the Port Hedland harbour developed by WorleyParsons during previous phases of work was expanded. The following describes the modelling process, results and recommendations.

## 1.2 Study Datum

All levels presented in this report are presented in terms of Chart Datum (CD) unless otherwise specified. Chart datum is 4.1m below MSL (McKimmie et al, 1987) which is approximately AHD.

The Universal Transverse Mercator Zone 50 South (UTM-50) and the Australian Geodetic 1994 (GDA94) coordinate systems were adopted for the horizontal projection systems. The numerical modelling results are presented in terms of UTM-50 with direction in degrees with respect to true north (°T).


**Figure 1-1 Proposed Dredging and Reclamation Areas**

# 2. REVIEW OF GEOLOGY AND SEDIMENTOLOGY

Coffey Geosciences Pty Ltd (Coffey, 2005) carried out a marine geotechnical study on the area adjacent to the proposed Anderson Point berth wharf structures. Twenty boreholes were drilled at various locations throughout the site, and laboratory tests on these samples were then conducted. Figure 2-1 indicates the borehole locations. The following briefly summarises the findings of the geotechnical study.

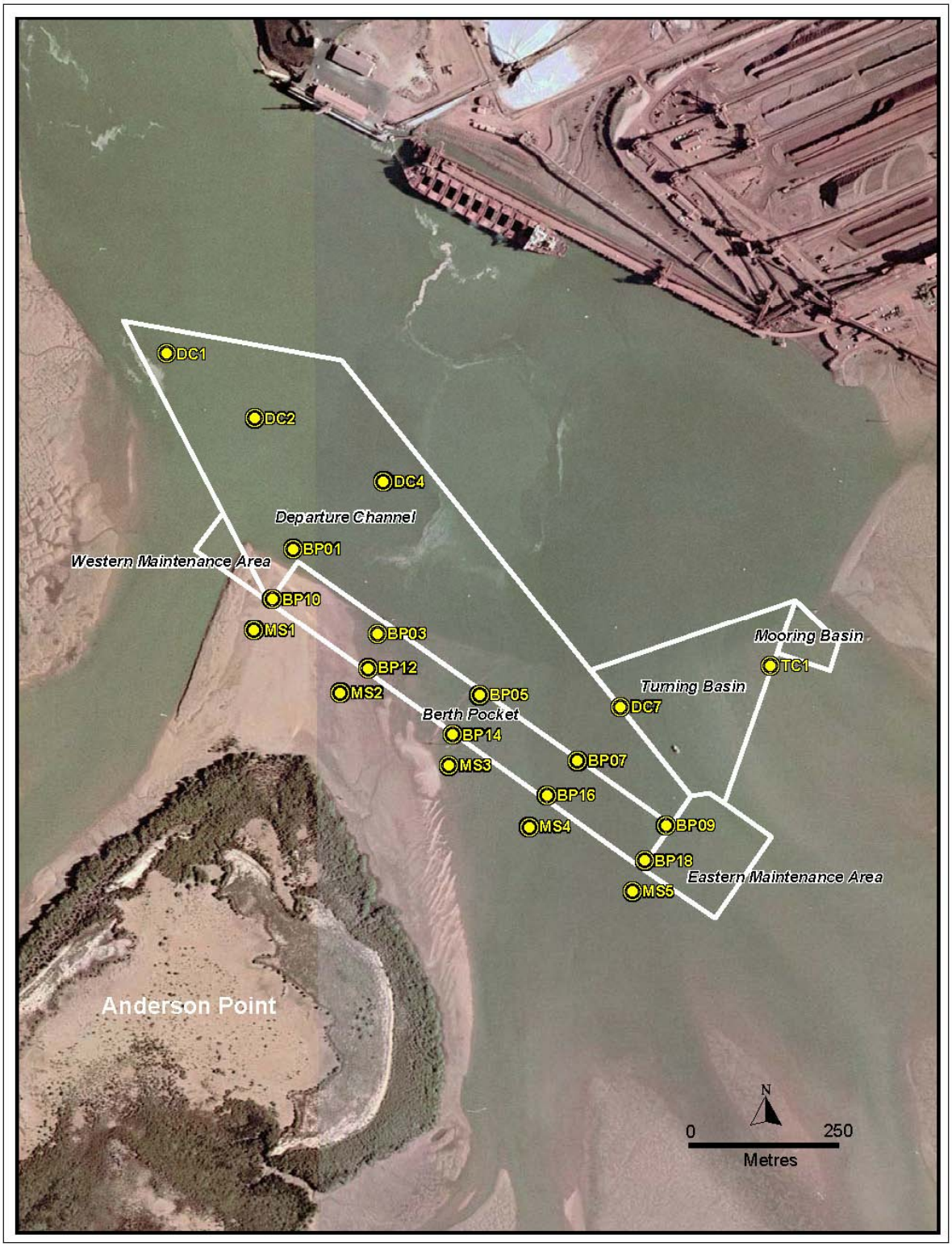


**Figure 2-1 Bore Hole Locations and Proposed Dredging Area**

## 2.1 Departure Channel and Turning Basin

### 2.1.1 Dredged Area

The previously dredged area was found to have soft black clayey silt in the top 0.5m of soil, overlying low strength quartz sand in a cemented clayey matrix, approximately 5m thick. Also present were siliceous calcarenite and angular to sub-rounded quartz.

Underlying this was a low to high strength quartz gravel/sand, angular to sub-rounded and very well cemented. Siliceous detrital limestone gravel was also present, as was a 0.4m band of extremely low strength calcite in one borehole sample.

Sediments at various depths were sampled for size distribution and the $D_{50}$ values are shown in Table 2.1. Sediment sizes range from 0.001 – 150mm.

**Table 2.1 $D_{50}$ of sediments at various depths within the departure channel and turning basin (dredged area) (adapted from Coffey, 2005)**

| Depth (m below seabed) | $D_{50}$ (mm) |
|---|---|
| 0.5-0.7 | 25 |
| 2-2.25 | 0.27 |
| 3.5-4 | 0.5 |

### 2.1.2 Natural Sea Bed Surface

The natural sea bed surface has a 0.3m layer of silt at one site, overlying very loose to medium dense gravely silty sand. This 1.0-1.2m thick layer also included clayey sand and sandy gravel.

Underlying this was a red brown, variably cemented, very stiff/dense clayey sand layer from -4.1m to -5.0m CD. Below this was a very low strength ~9m thick layer of a very weakly to moderately weakly cemented clayey matrix, containing very low strength quartz sand. Also present were siliceous calcarenite and angular to sub-rounded quartz gravel, extending down to -14.2m CD and at one site overlying very well cemented angular to sub-rounded quartz gravel/sand of low to medium strength.

$D_{50}$ values at various depths are indicated in Table 2.2. Sediment sizes range from 0.001 – 75mm.

**Table 2.2 $D_{50}$ of sediments at various depths within the departure channel and turning basin (natural seabed surface) (adapted from Coffey, 2005)**

| Depth (m below seabed) | $D_{50}$ (mm) |
|---|---|
| 0.5-0.8 | 16.1 |
| 1.5-2 | 0.28 |
| 5-5.5 | 0.55 |
| 7-7.5 | 0.33 |
| 8.5-9 | 0.45 |

## 2.2 Berth Pocket

The surface 2m consists of very loose to loose calcareous and silica silty and gravely sand. This overlies dense/very stiff to hard red brown, variably cemented clayey sand/sandy clay. Sand, gravels and cobbles of angular to sub-rounded shape and layers of uncemented silty sand are also present.

Underlying this is a ~6m thick moderately weakly cemented clayey matrix containing low strength quartz sand. With this are siliceous calcarenite and differing quantities of angular to sub-rounded quartz gravel.

This lies above 4m of very well cemented angular to sub-rounded quartz, limestone and ferruginous gravel/sand of very high to low strength, decreasing with depth.

Underlying this is another layer similar to the 6m thick layer described above but also containing bands of sand and siliceous calcarenite, and a trace of palygorskite, present as grey green clayey zones.

Median particle sizes at different depths are presented in Table 2.3. Particle sizes range from 0.001 – 75mm.

**Table 2.3 $D_{50}$ of sediments at various depths within the berth pocket (adapted from Coffey, 2005)**

| Depth (m below seabed) | $D_{50}$ (mm) |
|---|---|
| 1-1.3 | 0.36 |
| 1.5-1.8 | 1 |
| 1.5-2 | 0.2 |
| 2.4-2.6 | 0.3 |
| 3.7-4 | 0.16 |
| 6-6.3 | 0.21 |
| 6.3-6.6 | 1 |
| 6.7-6.9 | 0.33 |
| 10-10.5 | 0.9 |
| 11.5-12 | 0.22 |
| 12-12.3 | 4.48 |
| 17-17.3 | 17.86 |
| 20-20.5 | 0.33 |
| 21.6-22 | 2.22 |

## 2.3 Ground Conditions at the Wharf Location

The surface 2m comprise of loose to medium dense, calcareous silica sand, gravely sand and silty sand, and overlies red brown, variably cemented generally dense/very stiff to hard clays. Siliceous calcarenite and siliceous limestone are also included in bands, as are gravely layers with angular to sub-rounded quartz. Towards the northern end of the wharf at the base of this layer (-4.0 to -11.5m CD) are also layers of uncemented silty sand.

The next layer below is ~6m (down to about -14.3m CD) thick and consists of a very weakly to moderately cemented clayey matrix generally containing extremely low to low strength quartz sand, but also with bands of siliceous calcarenite, sand and limestone and angular to sub-rounded quartz gravel.

Below this is a 2m thick very well cemented quartz, limestone and ferruginous gravel/sand with high to low strength, decreasing with depth. This overlies another layer similar to the 6m layer above but contains sand, sandstone, calcarenite, conglomerate and siltstone and trace palygorskite. Underlying this is distinctly weathered, fine grained quartz with variable strength.

Median particle sizes at different depths are presented in Table 2.4. Sediment sizes range from 0.001-75mm.

**Table 2.4 $D_{50}$ of sediments at various depths within the wharf area (adapted from Coffey, 2005)**

| Depth (m below seabed) | $D_{50}$ (mm) |
|---|---|
| 1.5-1.7 | 0.24 |
| 4-4.5 | 0.43 |
| 7-7.5 | 0.35 |
| 8.6-8.9 | 0.79 |
| 14-14.2 | 0.70 |

# 3. DREDGING AND RECLAMATION

## 3.1 Introduction

The marine dredging component of FMG's proposed Pilbara Iron Ore and Infrastructure Project consists of a berthing pocket, turning basin, mooring basin, two maintenance areas and a departure channel. It is proposed that two areas be reclaimed with the dredge spoil. The dredging and reclamation areas are shown in Figure 1-1.

The total volume to be dredged is approximately 4.5 million cubic metres; constituents of this are shown in Table 3.1. It is proposed a cutter suction dredge will be used, dredging at a nominal production rate of approximately 2,000$m^3hr^{-1}$. It is estimated the dredging process will take approximately 7 months.

**Table 3.1 Approximate volume of material to be dredged**

| Location to be Dredged | Volume ($m^3$) | Area ($m^2$) |
|---|---|---|
| Berth Pocket (incl. slopes to -14.9m CD) | 1,951,000 | 90,000 |
| Departure Channel | 1,437,000 | 215,000 |
| Turning Basin | 338,000 | 45,000 |
| Eastern Dredging Maintenance | 240,000 | 22,000 |
| Western Dredging Maintenance | 74,000 | 6,000 |
| Mooring Basin | 24,000 | 6,000 |
| Slopes (excluding internal slopes) | 453,000 | 87,000 |

## 3.2 Turbidity Generation

### 3.2.1 Cutter Head

During the dredging, fine sediment will be resuspended by the cutter head action. A common measure of the sediment plume is by turbidity, usually expressed in NTUs. Turbidity is usually correlated to Total Suspended Sediment (TSS) concentration, although correlations vary greatly between sites. Modelling is most commonly undertaken with TSS as the variable for that reason, as both turbidity and TSS measurements at sites are usually limited.

The rate and concentration of the sediment resuspension is dependent on the thickness of the cut, rate of swing, cutter rotation rate and material to be dredged (Je & Kim, 2004). The likely suspended sediment concentration (TSS) in the vicinity of the cutter head during the proposed dredging is difficult to quantify a priori. A review of other dredging projects was conducted to estimate this value, for use in the dredge dispersion modelling.

A field study of a conventional cutter suction dredge conducted in James River, Norfolk Virginia USA by the US Army Corp of Engineers (USACE) in 1982 found suspended sediment concentrations of 46.6 – 65 $mgL^{-1}$ in depths of 6.4 – 7.6 m (Hayes et al, 1984).

In 1983 the Waterways Experiment Station (WES) conducted a field study during the maintenance dredging of the Savannah River Basin with a cutter suction dredge. Within 6m of the cutter head, values ranged from 46 – 1100$mgL^{-1}$ when the cutter was fully submerged, and 23-220$mgL^{-1}$ when the cutter was partially submerged (Hayes et al, 1984). Je & Kim (2004) quote a concentration of 324$mgL^{-1}$ at this location during the same study.

Field measurements made during the construction of the Corpus Christi Ship Channel, Texas USA found the near-bottom suspended sediment concentration within 2m of the cutter head to be 580$mgL^{-1}$, relative to the background concentrations of 39-209$mgL^{-1}$ (Herbich & Brahme 1984). Other data found by Herbich & Brahme ranged from 11.8 – 330$mgL^{-1}$.

Measurements of the suspended sediment concentration due to dredging with a cutter suction dredge were also made during the annual maintenance dredging in the Port of Rotterdam, Netherlands. Concentrations were found to be 120$mgL^{-1}$ at the surface, 150$mgL^{-1}$ midway through the water column, and 300$mgL^{-1}$ close to the bottom (Vellinga, 1989).

The redevelopment of the Brisbane International Airport required capital dredging of Middle Banks, Moreton Bay for reclamation for runways, taxiways and building foundations (Willoughby & Crabb, 1983). A trailing suction hopper dredge was used. Suspended sediment concentrations measured close to the dredge were 20 – 600$mgL^{-1}$ (Willoughby & Crabb, 1983).

Cullinane et al (1989) discusses alternatives for the disposal and control of contaminated sediments within dredge material. Suspended sediment concentration from a cutter head dredging operation near the cutter head was said to range from 200 – 300$mgL^{-1}$.

Table 3.2 shows a summary of the TSS values gathered. Based on these values a median suspended sediment concentration of 300$mgL^{-1}$ was selected as the source concentration near the cutter head for modelling purposes.

**Table 3.2 Suspended Sediment Concentration Summary**

| Reference | Location | TSS ($mgL^{-1}$) |
|---|---|---|
| Hayes et al, 1984 | James River, Norfolk Virginia USA | 46.6 – 65 |
| Hayes et al, 1984 | Savannah River Basin, Georgia USA | 23 – 1100 |
| Je & Kim 2004 | Savannah River Basin, Georgia USA | 324 |
| Herbich & Brahme 1984 | Corpus Christi Ship Channel, Texas USA | 580 |
| Herbich & Brahme 1984 | Unknown | 11.8 – 330 |
| Vellinga 1989 | Port of Rotterdam, Netherlands | 120 – 300 |
| Willoughby & Crabb 1983 | Middle Banks, Moreton Bay Australia | 20 – 600 |
| Cullinane et al (1989) | Unknown | 200 – 300 |

### 3.2.2 Tailwater

Tailwater will be discharged from both the proposed reclamation areas during reclamation (refer Figure 1-1 for reclamation area locations); Figure 3-1 shows the discharge locations. The northern reclamation will discharge to the east into the intersection of South, South East and Stingray creeks just south of Anderson Point. The southern reclamation will also discharge to the east, into the head of South Creek. In addition, the southern reclamation will discharge from an internal slimes pond to the west, into the head of South West Creek.

The tailwater discharge from the reclamation areas is expected to have a suspended sediment concentration of 150mg$L^{-1}$.


**Figure 3-1 Tailwater discharge locations**

### 3.2.3 Background Suspended Sediment and Turbidity

Turbidity was measured by a data logger deployed in Port Hedland Harbour in June/July 2005 for a period of two weeks. The range and mean turbidity values are displayed in Table 3.3. The turbidity values cannot be used directly for modelling purposes, as discussed in Section 3.2.1, but may be used during dredging as background comparisons. The values do highlight the naturally high turbidity levels in the Port Hedland Harbour. Note that a typical environmental target is around 20 NTU for estuaries in this region. Clear coastal waters typically exhibit values of 1-5 NTU.

**Table 3.3 Turbidity in Port Hedland harbour**

| | **Turbidity (NTU)** |
|---|---|
| **Min** | 33.8 |
| **Mean** | 80.8 |
| **Max** | 130.5 |

Water samples were taken from various locations throughout the harbour in September 2005. Values are shown in Table 3.4.

**Table 3.4 TSS from water samples**

| **Site** | **TSS ($mgL^{-1}$)** |
|---|---|
| Town Jetty | 44 |
| Boat Ramp | 49 |
| Mangroves | 31 |
| Mangroves Mud | 380 |
| Mangroves Deep | 18 |
| Creek | 30 |
| Creek Mud | 69 |

# 4. CIRCULATION MODELLING

To predict the behaviour of the dredge plume in the surrounding waters, a sophisticated and thorough investigation was required. The complexity of the local topography, which includes mangrove areas, required that an advanced numerical model be employed. WorleyParsons has previously modelled the Port Hedland harbour using EFDC. Based on the requirements of the study site and this previous experience, the EFDC model was again selected for use in this study. EFDC has been widely used in the United States for a variety of environmental assessments, and importantly, has gained credibility with the US EPA and other regional authorities.

The EFDC model was developed by John Hamrick, formerly of the Virginia Institute of Marine Science, in the early 1990's, with development continuing to the present day. EFDC offers both regular Cartesian grids, and a curvilinear orthogonal system, which allows a continuous representation of features such as channels, coastlines and bottom contours. The model has a sigma, or stretched, grid in the vertical that allows a constant proportionate resolution throughout the domain. Further information on the EFDC model is available in Hamrick (1992), Hamrick (1992b), Hamrick et al (1995) and Hamrick and Wu (1997).

WorleyParsons has previously applied EFDC to model dredge plume dispersion in Cockburn Sound, at Barrow Island and in Napier, New Zealand.

## 4.1 Bathymetry and Model Domain

The domain of the model grid from previous work was expanded to include the surrounding coastal region and is shown in Figure 4-1. It extends 29km in the North/South direction and 44km in the East/West direction. The domain has open ocean boundaries to the north, west and east.

To expand the existing model grid, bathymetric data relative to chart datum was obtained from Aus charts 52, 53, 54 and 740, and 'Approaches to Port Hedland' (McKimmie et al, 1987). The model bathymetry is shown in Figure 4-2; displayed eastings and northings are to GDA94.

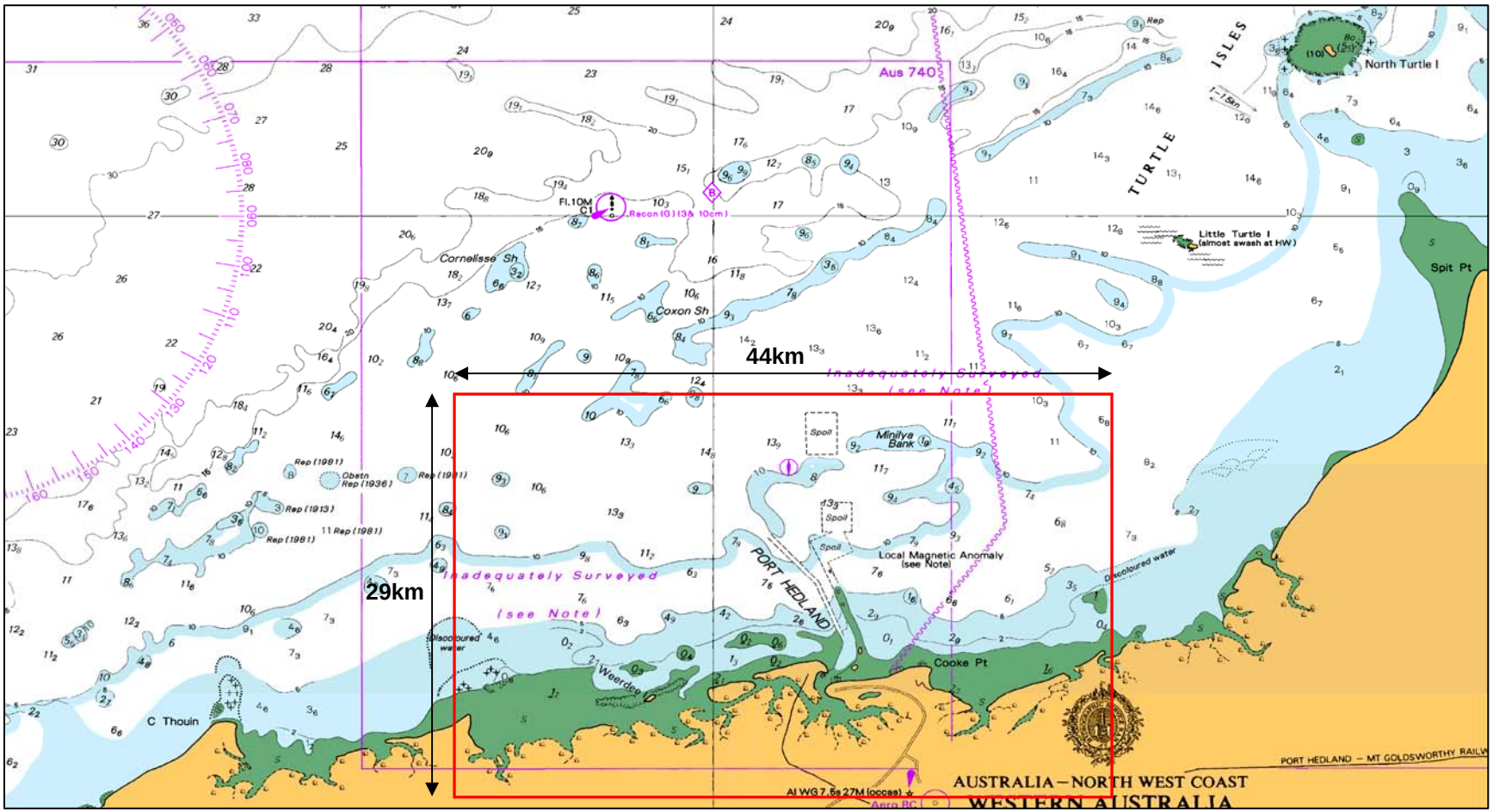


**Figure 4-1 Model Domain (Aus 326)**

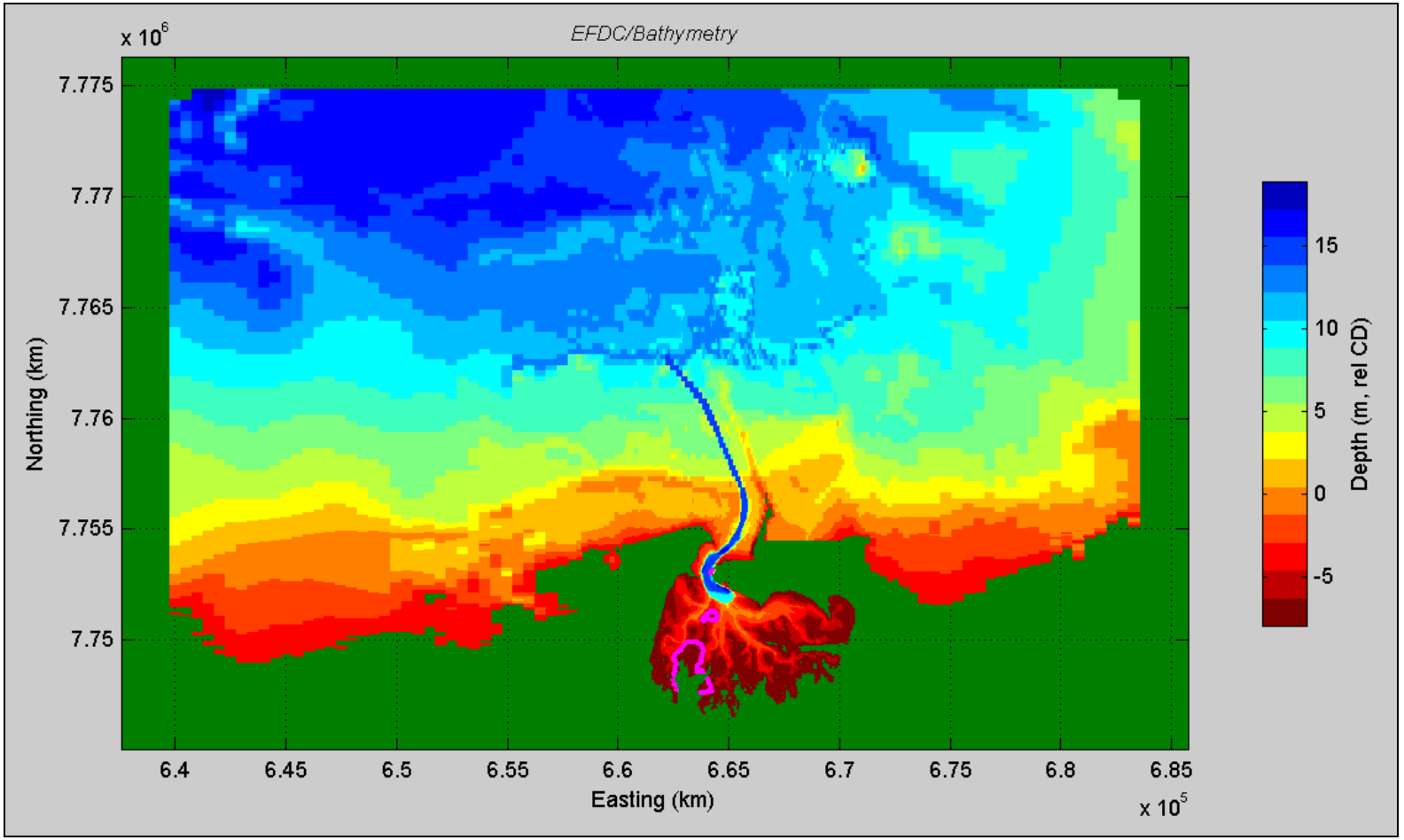


**Figure 4-2 Model domain and bathymetry (m CD)**

## 4.2 Model Forcing

The model has open boundaries to the east, west and north. Tidal forcings were applied along the length of all three boundaries, and wind applied spatially over the domain.

### 4.2.1 Wind Analysis

Wind data was obtained from the Bureau of Meteorology (BOM) for the period 1998-2004 inclusive. This data was analysed to select a set of typical seasons to model.

#### 4.2.1.1 Wind Roses

Wind roses were generated for the 1998-2004 time series, and in monthly intervals. The overall wind rose is shown in Figure 4-3. Monthly wind roses are shown in Appendix A.

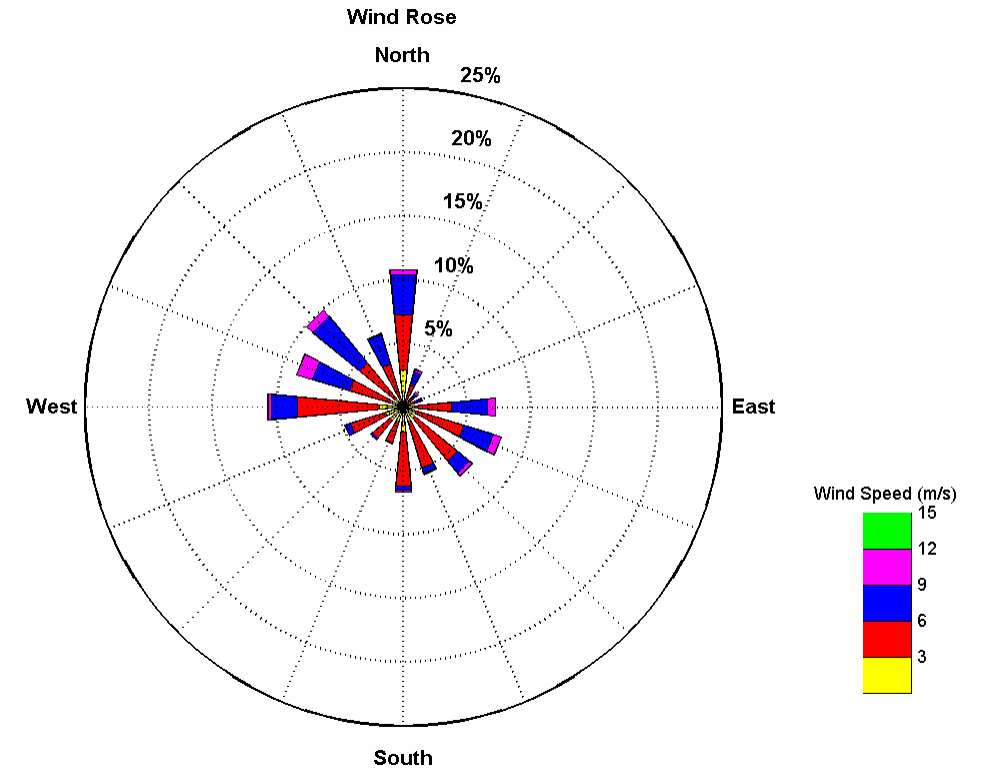


**Figure 4-3 Wind Rose for the dataset 1998-2004**

Figure 4-3 indicates the wind is either from the North-West (most dominant) or the South-East. Monthly wind roses indicate the north-westerly winds are most prevalent from September – February, and the south-easterly winds generally occur from March – August.

#### 4.2.1.2 Joint Frequency Tables

Joint frequency tables were generated for the dataset as a whole and in monthly groups. The overall table is shown below in Table 4.1. Table 4.1 indicates 99.7% of wind is less than 12 ms$^{-1}$, 50% of all wind is between 3-6 ms$^{-1}$, and 95% is less than 9 ms$^{-1}$. Winds are from the North-West quadrant 47% of the time, and from the South-East quadrant 35% of the time.

**Table 4.1 Joint Frequency Table of Wind Direction vs Wind Speed for the whole dataset 1998-2004**

| Dir (°)/Spd (m/s) | 0-3 | 3-6 | 6-9 | 9-12 | 12-15 | 15-18 | 18-21 | 21-24 | 24-27 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| **N** | 2.98 | 4.39 | 3.20 | 0.43 | 0.01 | 0 | 0.01 | 0.01 | 0* | **11.01** |
| **NNE** | 0.39 | 1.55 | 0.98 | 0.24 | 0.02 | 0 | 0.01 | 0.01 | 0 | **3.18** |
| **NE** | 0.29 | 0.61 | 0.48 | 0.12 | 0.02 | 0* | 0.01 | 0 | 0 | **1.53** |
| **ENE** | 0.39 | 0.64 | 0.49 | 0.07 | 0* | 0.01 | 0* | 0* | 0 | **1.61** |
| **E** | 0.91 | 2.93 | 2.88 | 0.66 | 0.03 | 0* | 0 | 0 | 0 | **7.41** |
| **ESE** | 1.01 | 4.04 | 2.51 | 0.62 | 0.03 | 0.01 | 0.01 | 0 | 0 | **8.21** |
| **SE** | 1.19 | 4.40 | 1.19 | 0.33 | 0.03 | 0.01 | 0* | 0 | 0 | **7.15** |
| **SSE** | 1.34 | 3.74 | 0.46 | 0.07 | 0.03 | 0.01 | 0.01 | 0 | 0 | **5.65** |
| **S** | 1.97 | 4.38 | 0.33 | 0.10 | 0.02 | 0 | 0 | 0 | 0 | **6.80** |
| **SSW** | 1.33 | 1.65 | 0.13 | 0.01 | 0.01 | 0* | 0 | 0 | 0 | **3.12** |
| **SW** | 1.36 | 1.89 | 0.18 | 0.02 | 0* | 0 | 0 | 0 | 0 | **3.44** |
| **WSW** | 1.49 | 2.97 | 0.41 | 0.04 | 0* | 0 | 0 | 0 | 0 | **4.90** |
| **W** | 1.90 | 6.63 | 2.06 | 0.27 | 0.02 | 0 | 0 | 0 | 0 | **10.88** |
| **WNW** | 1.01 | 3.52 | 3.10 | 1.27 | 0.03 | 0 | 0 | 0 | 0 | **8.93** |
| **NW** | 0.83 | 3.75 | 4.77 | 0.70 | 0.01 | 0 | 0 | 0 | 0 | **10.05** |
| **NNW** | 0.68 | 2.92 | 2.44 | 0.09 | 0* | 0 | 0* | 0* | 0 | **6.13** |
| **Total** | **19.04** | **50.00** | **25.60** | **5.03** | **0.25** | **0.03** | **0.03** | **0.01** | **0.00** | **100** |

Note: * denotes values <0.01

#### 4.2.1.3 Statistics

The minimum, median, mean, 20th, 80th, 95th, 98th percentile, and maximum wind speed were calculated for the dataset as a whole and by month, and are displayed in Table 4.2. The median, 98th percentile and maximum for each month are also displayed in Figure 4-4. These statistics indicate the presence of a seasonal trend in wind speed; wind speeds in the summer period are generally higher than those in winter.

**Table 4.2 Statistics of Wind Speed ($ms^{-1}$) for the dataset as a whole and by month**

| | Mean | 20th%tile | Median | 80th%tile | 95th%tile | 98th%tile | Maximum |
|---|---|---|---|---|---|---|---|
| **All** | 4.88 | 3.06 | 4.72 | 7.22 | 9.17 | 10.28 | 24.72 |
| **Jan** | 5.44 | 3.06 | 5.00 | 7.78 | 9.72 | 10.83 | 17.50 |
| **Feb** | 5.15 | 3.06 | 4.72 | 7.22 | 9.72 | 10.83 | 15.83 |
| **Mar** | 4.82 | 2.50 | 4.17 | 6.67 | 9.17 | 10.83 | 21.11 |
| **Apr** | 4.26 | 2.50 | 3.61 | 6.11 | 8.33 | 9.17 | 20.56 |
| **May** | 4.40 | 2.50 | 4.17 | 6.11 | 8.33 | 9.17 | 12.78 |
| **Jun** | 4.55 | 3.06 | 4.17 | 6.11 | 8.61 | 9.17 | 11.67 |
| **Jul** | 4.36 | 2.50 | 4.17 | 6.11 | 8.33 | 9.72 | 12.78 |
| **Aug** | 4.44 | 2.50 | 4.17 | 6.11 | 8.61 | 9.72 | 13.33 |
| **Sep** | 4.67 | 2.50 | 4.17 | 6.67 | 8.61 | 9.72 | 13.33 |
| **Oct** | 5.11 | 3.06 | 4.72 | 7.22 | 9.17 | 10.28 | 12.22 |
| **Nov** | 5.55 | 3.06 | 5.83 | 7.78 | 9.17 | 10.28 | 12.78 |
| **Dec** | 5.75 | 3.61 | 5.83 | 7.78 | 9.72 | 11.19 | 24.72 |

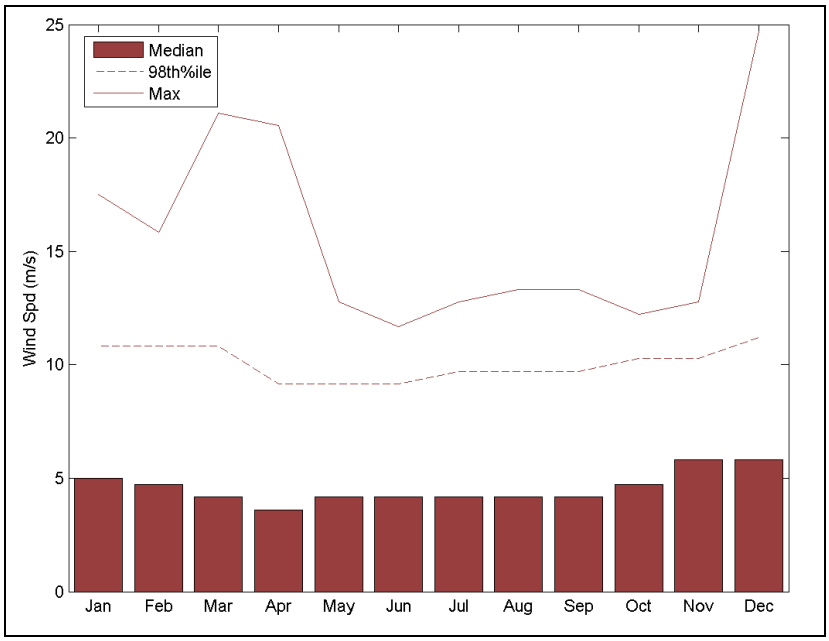


**Figure 4-4 Median, 98% ile and Maximum Wind Speed for each month**

#### 4.2.1.4 Summary

Examination of the wind data presented indicates two main seasons: summer and winter, and a transition period occurring between the two. Summer winds are generally stronger than winter winds, and come from the north-west quadrant. Winter winds come from the south-east quadrant, and winds during the transition period come from both areas and have an intermediate magnitude.

Based on the available data, January, March and June 2004 were selected as being representative of the overall summer, transition and winter seasons respectively.

### 4.2.2 Tidal Forcing

Tidal data was generated for Port Hedland for the months of January, March and June 2004. These series and the wind forcing data for the same time periods are shown in Figures 4-4 to 4-6.

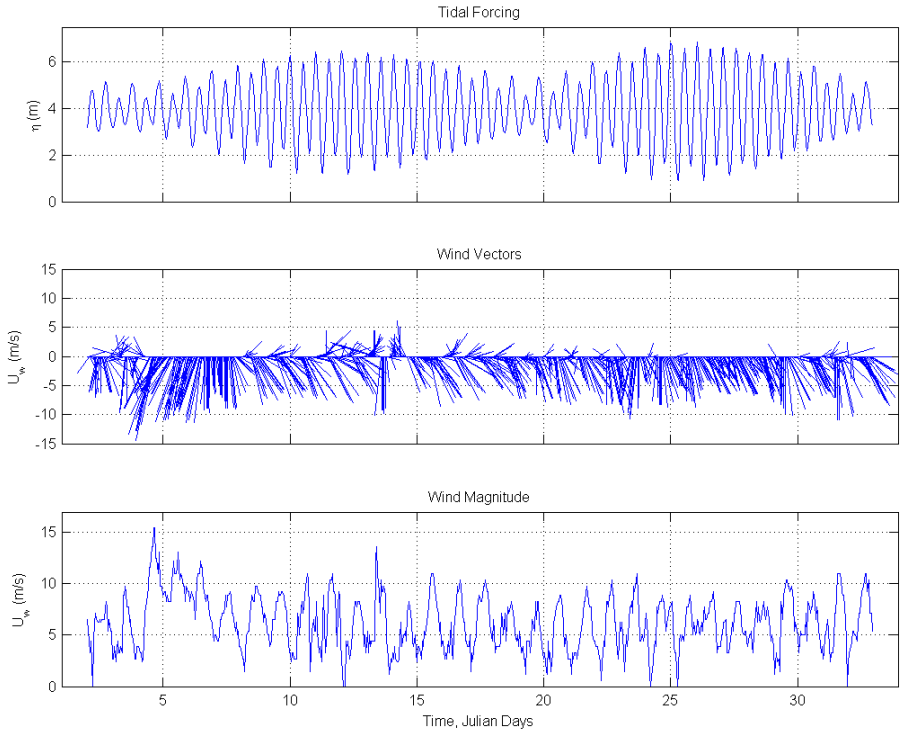


**Figure 4-5 Tide and Wind Forcing, Summer (January 2004)**

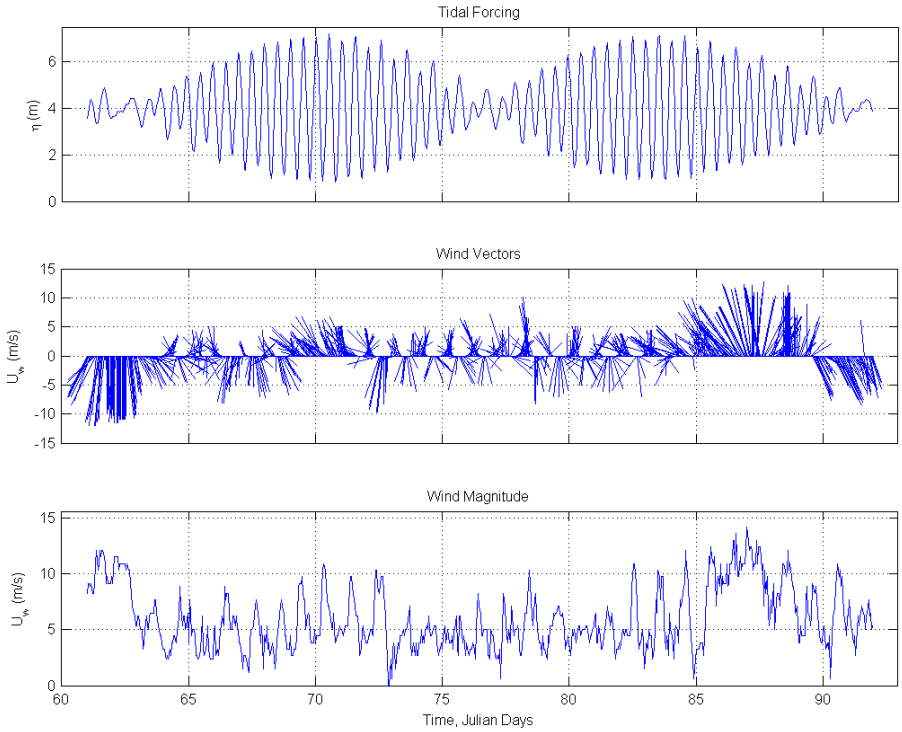


**Figure 4-6 Tide and Wind Forcing, Transition (March 2004)**

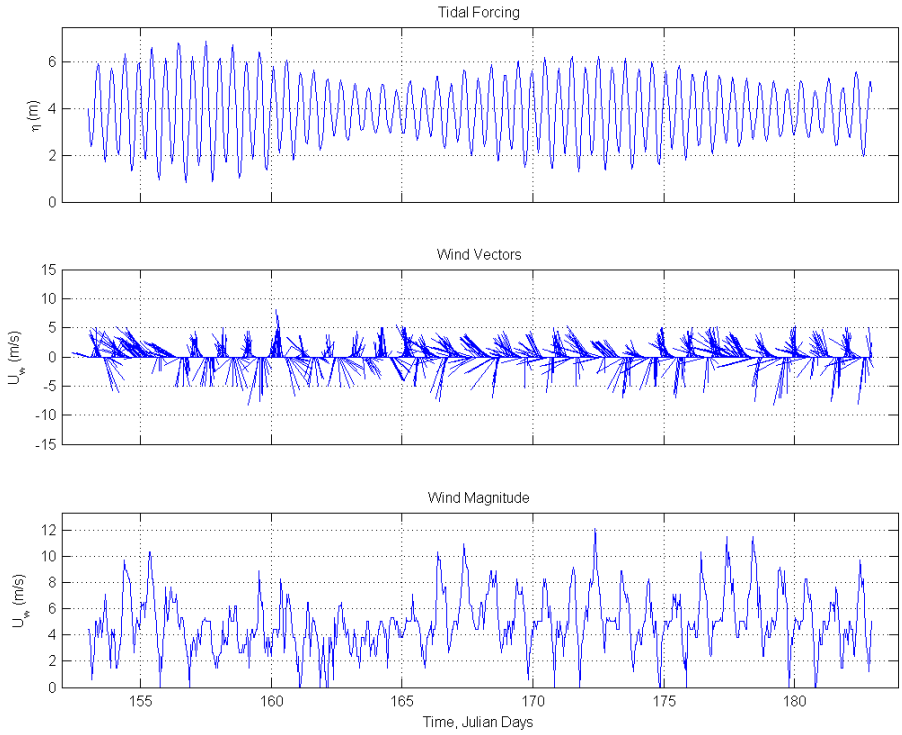


**Figure 4-7 Tide and Wind Forcing, Winter (June 2004)**

## 4.3 Model Scenarios

Based on the wind analysis, the following model scenarios were undertaken:

**Scenario 1.** A one month period during January 2004 that includes spring and neap tides, and wind data analysed in Section 4.2.1 (refer Figure 4-5). This is representative of the summer period.

**Scenario 2.** A one month period during March 2004 that includes spring and neap tides, and wind data analysed in Section 4.2.1 (refer Figure 4-6). This is representative of the transition period.

**Scenario 3.** A one month period during June 2004 that includes spring and neap tides, and wind data analysed in Section 4.2.1 (refer Figure 4-7). This is representative of the winter period.

## 4.4 Model Validation

In the absence of other suitable data, spring tide tidal stream rates from information given on the chart - 'Approaches to Port Hedland' (McKimmie et al, 1987) were used to validate the model results. The simulation results were compared to the tidal stream information at six locations within Port Hedland Harbour, the locations of the points are shown on Figure 4-8. Table 4.3 presents the comparison of the spring tide current magnitudes from the chart and from model results for the six points at hourly intervals over the tidal cycle (12 hours).

The model results are seen to be quite good and comparable with the magnitudes of the tidal streams given on the chart, particularly for points R, S and T which are located in the vicinity of the proposed FMG berth. The results were considered to demonstrate an acceptable match to observations, and the model was therefore applied in the simulation of the dredging dispersion.

**Table 4.3: Comparison of model output spring tide current magnitudes and observations displayed on chart – 'Approaches to Port Hedland' (McKimmie et al, 1987).**

| | Hours | M | | O | | Q | | R | | S | | T | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | obs | mod | obs | mod | obs | mod | obs | mod | obs | mod | obs | mod |
| Before HW | 6 | 0.05 | 0.15 | 0.00 | 0.00 | 0.03 | 0.03 | 0.09 | 0.01 | 0.03 | 0.04 | 0.00 | 0.03 |
| | 5 | 0.25 | 0.10 | 0.23 | 0.08 | 0.21 | 0.09 | 0.13 | 0.06 | 0.09 | 0.10 | 0.03 | 0.03 |
| | 4 | 0.49 | 0.13 | 0.34 | 0.24 | 0.33 | 0.23 | 0.42 | 0.38 | 0.28 | 0.37 | 0.10 | 0.08 |
| | 3 | 0.88 | 0.60 | 0.65 | 0.50 | 0.56 | 0.46 | 0.62 | 0.58 | 0.62 | 0.56 | 0.08 | 0.13 |
| | 2 | 1.05 | 0.85 | 0.57 | 0.67 | 0.67 | 0.59 | 0.78 | 0.70 | 0.55 | 0.55 | 0.06 | 0.12 |
| | 1 | 0.87 | 0.88 | 0.50 | 0.65 | 0.52 | 0.55 | 0.54 | 0.60 | 0.44 | 0.49 | 0.08 | 0.04 |
| | HW | 0.50 | 0.45 | 0.18 | 0.21 | 0.26 | 0.14 | 0.29 | 0.27 | 0.32 | 0.23 | 0.27 | 0.19 |
| After HW | 1 | 0.75 | 0.42 | 0.58 | 0.68 | 0.68 | 0.73 | 0.49 | 0.47 | 0.44 | 0.48 | 0.12 | 0.25 |
| | 2 | 1.23 | 0.64 | 0.80 | 0.79 | 0.92 | 0.78 | 0.57 | 0.67 | 0.57 | 0.66 | 0.05 | 0.08 |
| | 3 | 0.86 | 0.74 | 0.23 | 0.64 | 0.57 | 0.65 | 0.78 | 0.75 | 0.82 | 0.78 | 0.05 | 0.07 |
| | 4 | 0.68 | 0.54 | 0.11 | 0.33 | 0.35 | 0.31 | 0.67 | 0.58 | 0.59 | 0.70 | 0.02 | 0.07 |
| | 5 | 0.32 | 0.28 | 0.00 | 0.11 | 0.10 | 0.11 | 0.09 | 0.10 | 0.26 | 0.27 | 0.03 | 0.04 |
| | 6 | 0.02 | 0.18 | 0.00 | 0.03 | 0.03 | 0.04 | 0.08 | 0.01 | 0.03 | 0.06 | 0.00 | 0.02 |

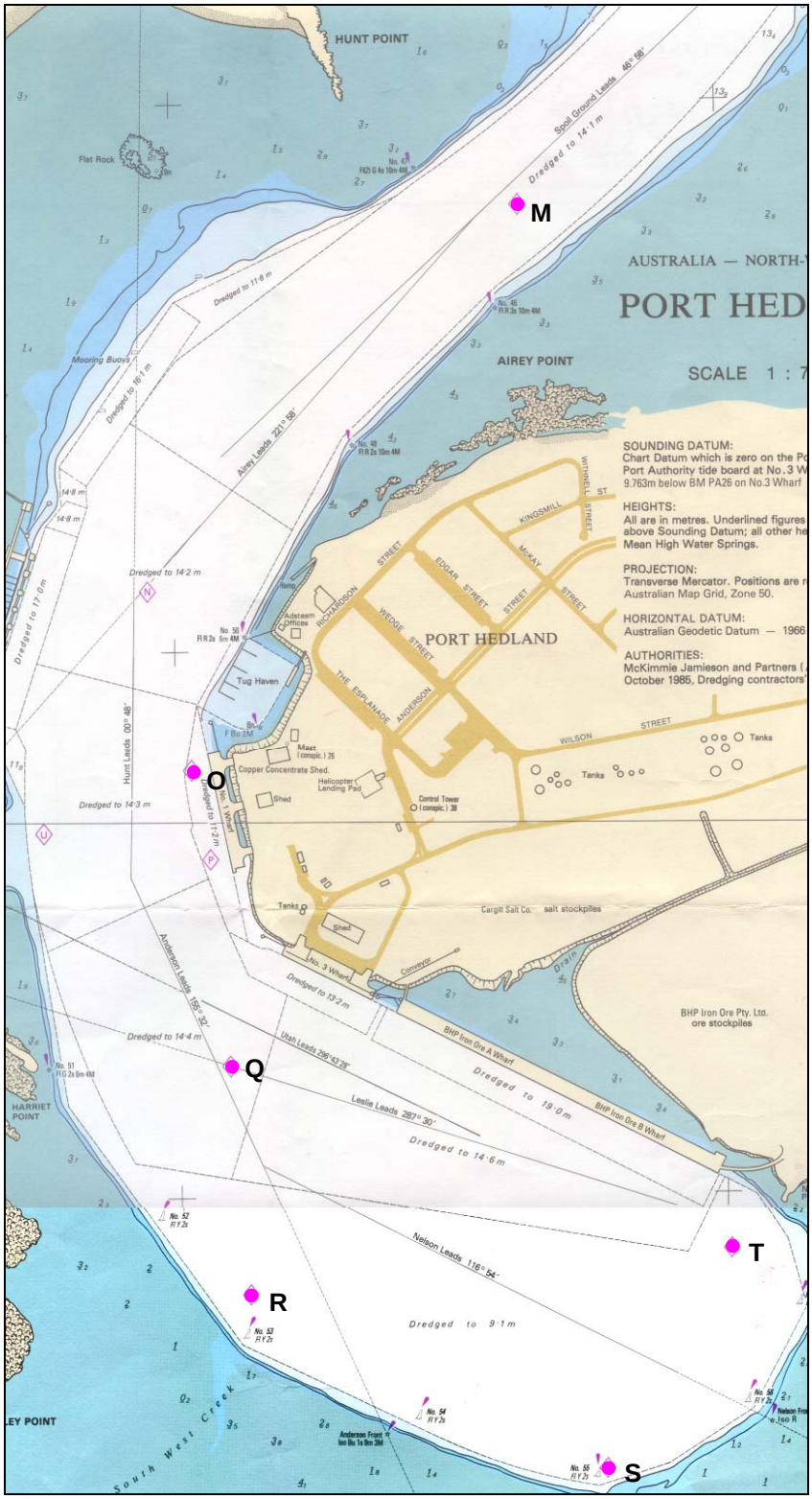


**Figure 4-8: Location of Tidal Stream validation points shown on Chart – 'Approaches to Port Hedland' (McKimmie et al, 1987).**

## 4.5 Model Results

Maps of current magnitude with current vectors overlain are shown for the ebb and flood spring tide for each simulation scenario in Figures 4-8 to 4-10. Bommie locations are also indicated in red. These figures show that currents within the harbour are predicted to be up to $1ms^{-1}$.

The current maps give an indication of the expected dispersion of the suspended sediment plume generated by the cutter suction dredging and the tailwater discharge. Flow through the harbour past Anderson Point indicates suspended sediment generated by the cutter suction dredging has the potential to disperse through the adjacent creeks. However, given the currents in the creeks are weaker the majority of the sediment is likely to remain near the dredged area, and then flush out of the harbour through the channel.

The tailwater discharge to the east from the stockpile reclamation is expected to flow up South Creek, and then behave in a similar fashion to the island reclamation tailwater discharge. The concentrations along South Creek are expected to be higher, as the currents are small and the water is very shallow. The discharge plume from the slimes pond is expected to behave similarly.

It is not expected that coral bommies WFO and PHO will be significantly affected by the plume, as they are sheltered and distant from the flow. Coral bommie location EFO is in a less sheltered position so may experience slightly elevated suspended sediment concentrations under some conditions.

The seasonal wind patterns described in section 4.2.1 indicate that upon exiting the harbour, the plume will generally travel more to the east during summer, to the west during winter, and be more variable during the transition period.

(a)

(b)

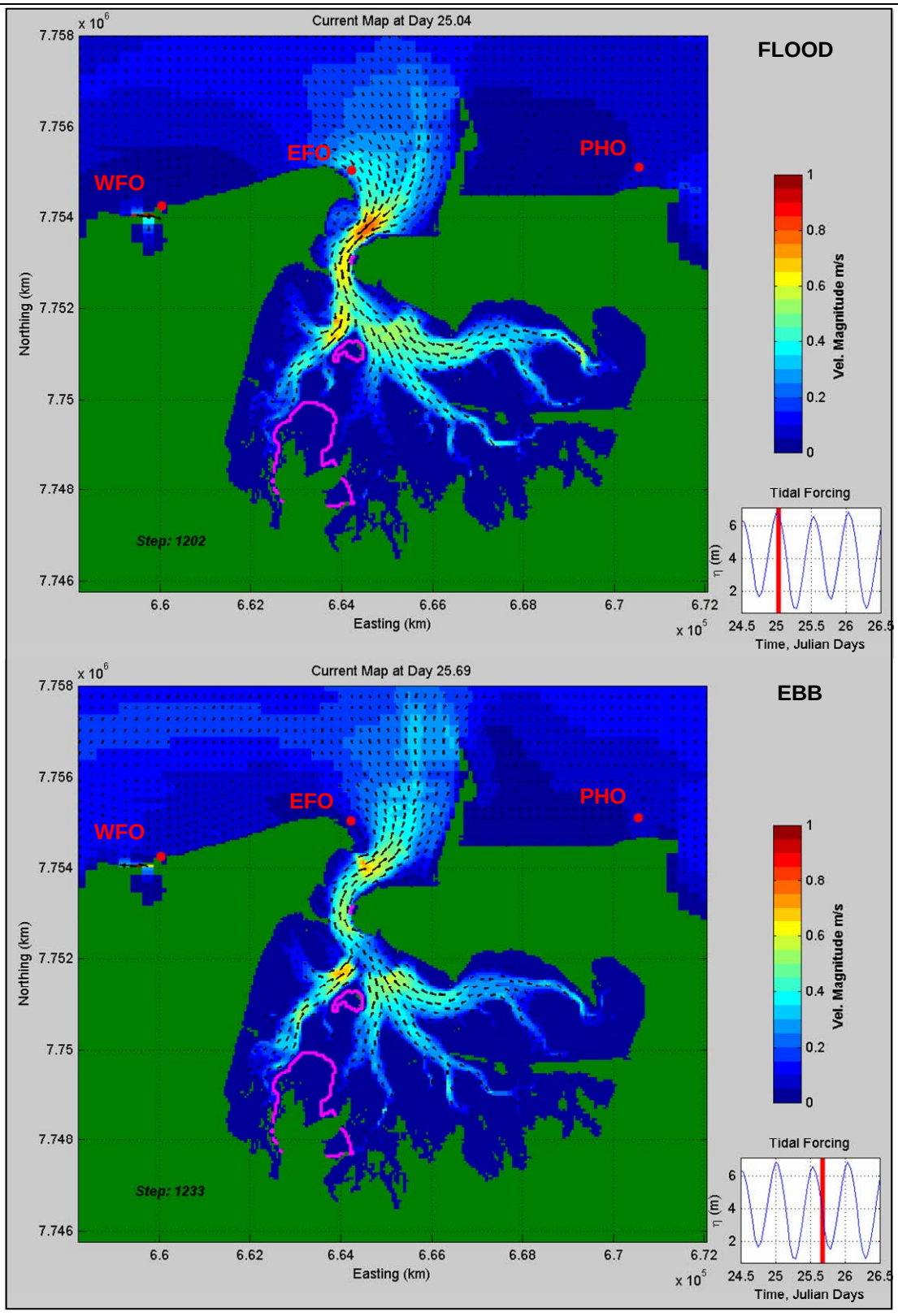


**Figure 4-9 Current magnitude map with overlain currents for Summer (Scenario 1): (a) flood tide, and (b) ebb tide**

(a)

(b)

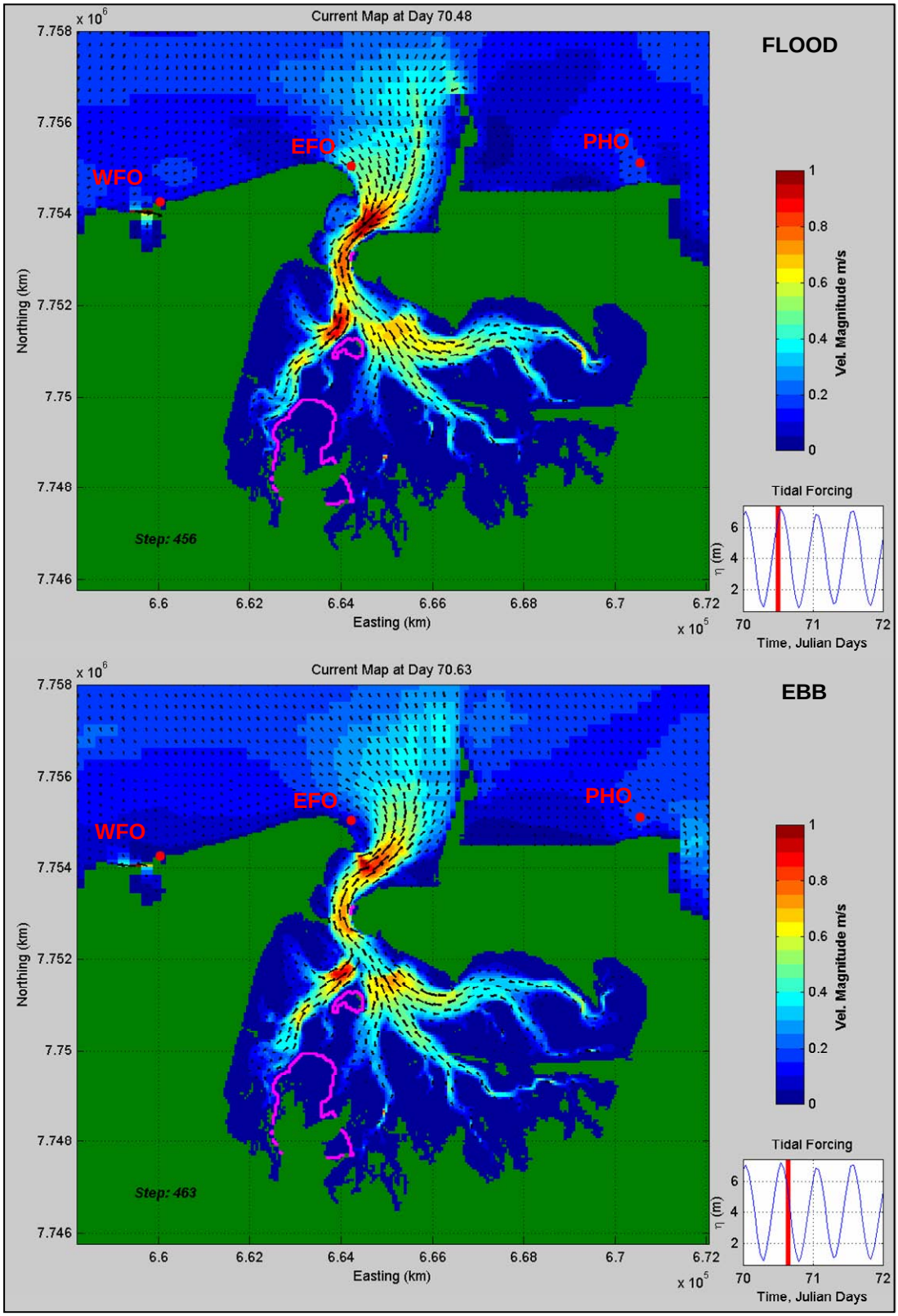


**Figure 4-10 Current magnitude map with overlain currents for Transition (Scenario 2): (a) flood tide, and (b) ebb tide**

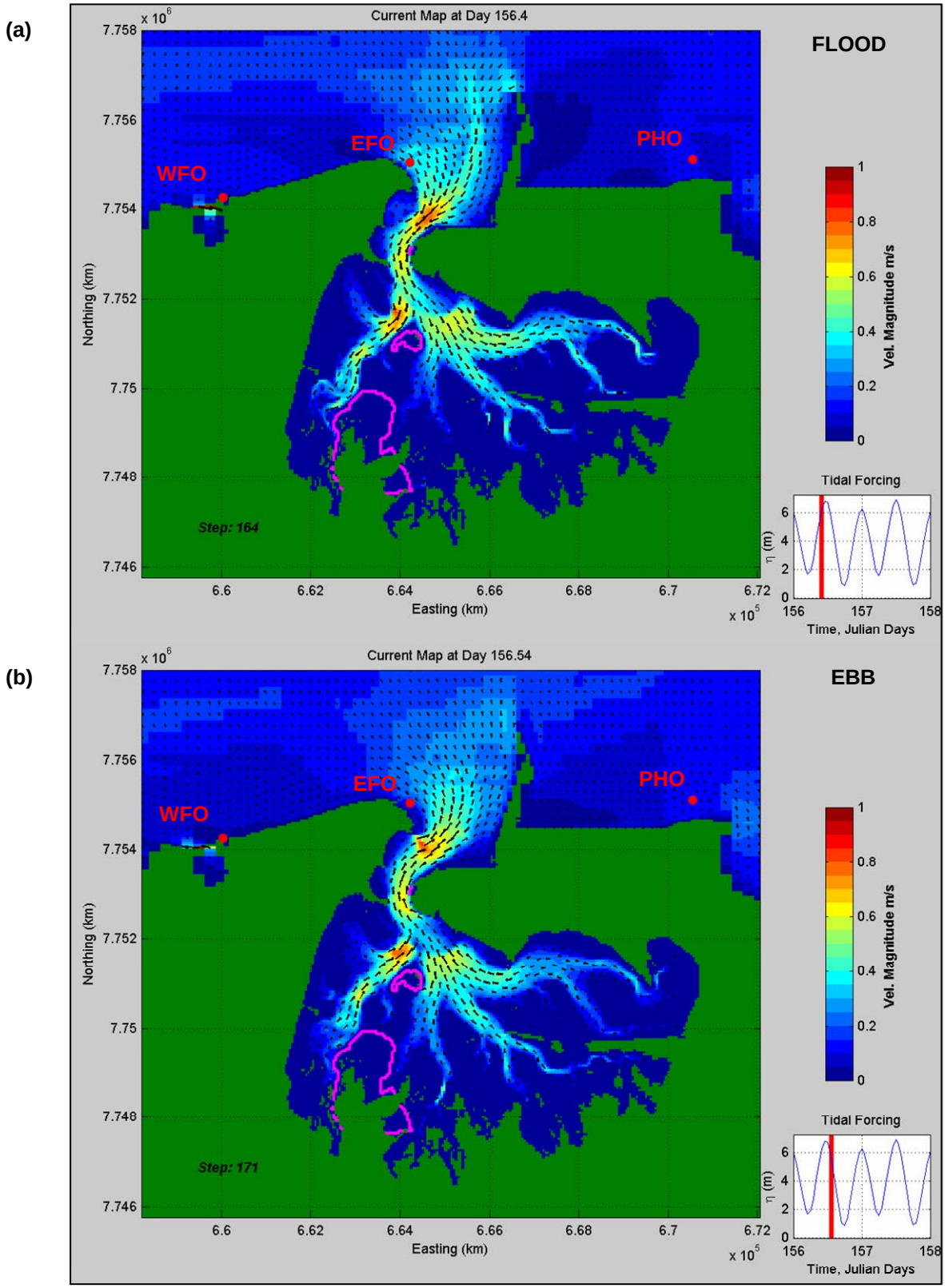


**Figure 4-11 Current magnitude map with overlain currents for Winter (Scenario 3): (a) flood tide, and (b) ebb tide**

# 5. DREDGING IMPACT ASSESSMENT

## 5.1 Dredging and Reclamation Methodology

During the dredging fine sediment will be generated at the cutter head and will be present in the water discharged from the reclamation areas. Consequently modelling of plume dispersion has focussed on both these aspects.

Based on the available quantitative data, the following assumptions were made:

- Dredging conducted at a constant rate of 10,000$m^3hr^{-1}$: 20% solids, 80% water
- Suspended sediment concentration in the vicinity (within 10m) of the cutter head: 300$mgL^{-1}$.
- Suspended sediment concentration in the reclamation discharge waters: 150$mgL^{-1}$.

## 5.2 Plume Dispersion Modelling

### 5.2.1 Modelling Methodology

To assess the impact of the release and dispersion of sediments, numerical modelling of dredge material dispersion was conducted using a particle tracking extension of the EFDC model.

The particle tracking extension incorporates variable settling rates and allows the particles to be grounded. The model itself relies on the input of the EFDC grid system, together with the velocity fields output from EFDC, including allowing for wetting and drying effects and a number of diffusion models. For the simulation of the dredged material, all particles were released at the water surface. The temporal output of the EFDC model is relatively coarse (half-hourly), so the particle model is run on a sub-time step to ensure that the appropriate advection fields are used.

To remain conservative a constant lateral dispersion coefficient of 1$m^2s^{-1}$ was applied. Acceptable values range between $10^{-2}$ and $10^2m^2s^{-1}$.

### 5.2.2 Simulation Scenarios

Dredge plume scenarios were run for seven release positions (L1 to L7) within the proposed dredged area in order to obtain adequate coverage of the areas to be dredged while minimising computational demand. The easting and northing of each of these points are presented in Table 5.1, and the locations of the points are shown on Figure 5-1. Each plume was released with a suspended sediment concentration of 300$mgL^{-1}$ within 10m of the cutter head.

Tailwater plume scenarios were run for three release positions (northern, southern and slimes), to represent the tailwater discharge from the reclamation areas. The coordinates and location of these points are also presented in Table 5.1 and Figure 5-1 respectively. At the release positions, the suspended sediment concentration in the tailwater discharge was set to 150$mgL^{-1}$.

The 10 dispersion modelling scenarios were run for each of the three seasonal circulation model scenarios, and a total of 30 dispersion scenarios resulted.


**Figure 5-1 Dispersion modelling release positions**

**Table 5.1 Easting, northing coordinates of scenario release positions**

| Release Site | Easting (m) | Northing (m) |
|---|---|---|
| L1 | 664,273 | 7,752,061 |
| L2 | 664,557 | 7,751,790 |
| L3 | 664,496 | 7,751,663 |
| L4 | 664,790 | 7,751,463 |
| L5 | 664,539 | 7,751,975 |
| L6 | 665,018 | 7,751,582 |
| L7 | 665,020 | 7,751,332 |
| N | 664,650 | 7,751,050 |
| S | 664,250 | 7,747,950 |
| SS | 662,500 | 7,749,100 |

### 5.2.3 Results

For each model cell in each simulation, a time-series of TSS in $mgL^{-1}$ was generated for each of the 30 dispersion scenarios simulated. These were then combined to display an overall representation of the dredging/reclamation process for each season, presented in Figure 5-3 to Figure 5-5. This involved taking the maximum of the 7 modelled dredging sites and the sum of the three reclamation scenarios, which represented the constant tailwater discharge and the discrete dredging process. These figures do not present a predicted outcome at any particular instant in time, but a representation of the spatial nature of impacts over the whole dredging/reclamation program.

Also displayed in Figure 5-3 to Figure 5-5 are time-series plots of the three coral bommie locations and a point inside the harbour. At each time-step, the value displayed in the time-series plot is the maximum of the 7 dredging scenarios plus the sum of the three reclamation scenarios at that time step, for the specific season and location. The easting and northing of the 3 coral points and harbour location are presented in Table 5.2 and shown in Figure 5-2 overlain on the EFDC model bathymetry. Statistics of the time series plotted in Figure 5-3 to Figure 5-5 are also shown in Table 5.3.

**Table 5.2 Easting, northing coordinates of coral bommies and harbour point**

| | Easting (m) | Northing (m) |
|---|---|---|
| **EFO** | 664,219 | 7,755,036 |
| **WFO** | 660,041 | 7,754,254 |
| **PHO** | 670,544 | 7,755,106 |
| **Harbour** | 664,250 | 7,752,050 |

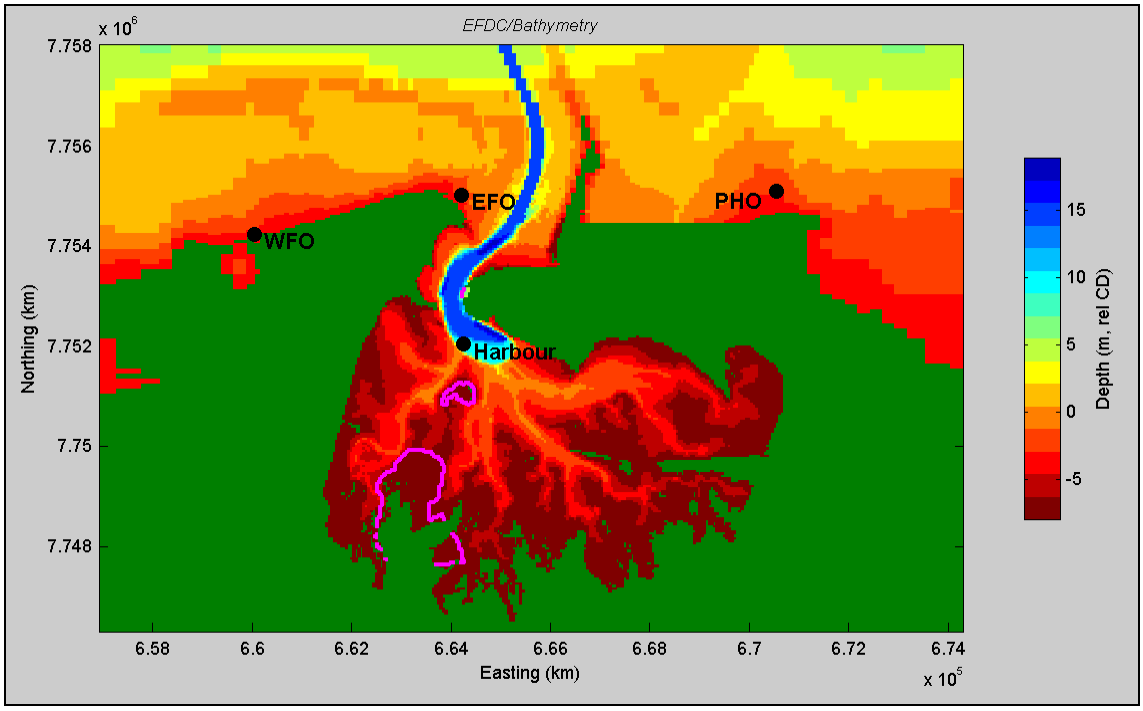


**Figure 5-2 Location of coral bommies and harbour point overlain on the EFDC model bathymetry**

**Table 5.3 Median, 80th and 95th percentiles, and maximum concentration at the coral bommies and harbour point**

| Site | Median | | | 80%ile | | | 95%ile | | | Max | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sum | Trans | Win | Sum | Trans | Win | Sum | Trans | Win | Sum | Trans | Win |
| **EFO** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.4 | 2.9 | 1.8 | 8.5 | 26.9 |
| **WFO** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.6 | 0 | 1.6 |
| **PHO** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.2 | 0 | 0 |
| **Harbour** | 10.0 | 8.4 | 14.3 | 17.3 | 14.9 | 25.4 | 26.9 | 23.7 | 40.3 | 77.2 | 76.9 | 75.1 |

Figure 5-3 to Figure 5-5 indicates that the particle dispersion is similar for all three circulation scenarios. The modelling predicts that the dredging and reclamation works will not cause an increase above background levels in the suspended sediment concentrations at the coral bommie sites WFO and PHO. At coral bommie site EFO, there is no predicted increase in TSS during summer, but there is a very small increase for a small period of time in the transition season (March) and more so in winter. The magnitude of the increase in TSS at this site is small, it's maximum value is the same order of magnitude as the background levels quoted in Section 3.2.3, so is unlikely to have a significant effect on the site.

The concentrations at the site in the harbour are predicted to increase by up to 77mgL$^{-1}$ for the summer and transition periods, and 75mgL$^{-1}$ for the winter period. The concentration varies with the

tidal flow, as expected. These increases in concentration are of the same order of magnitude as background levels (Section 3.2.3), so are also unlikely to have a significant effect on the harbour.

The highest concentrations are predicted to occur along South and South-West creeks, as well as the area immediately to the west of the spit at the harbour mouth. It should be noted that the 95$^{th}$ percentile concentrations are over all dispersion simulations for that season, so these concentrations could have occurred at any instant in time during the simulation, and not for the whole period. A better indication of the likely conditions during the dredging/reclamation program is given by the median values displayed in the figures. With the exception of the regions immediately surrounding the tailwater discharge sites, median TSS concentrations are typically <100mgL$^{-1}$.

The majority of the material in the tailwater discharge is expected to be fines, so it is likely that after the dredging and reclamation program is complete, the excess sediment in the creeks will quickly dissipate. The concentration in the creeks and the area adjacent to the spit is also exacerbated due to the highly tidal nature of the harbour. At low tide, these areas are extremely shallow, so the concentration at this time will be high, even if the total mass present is small.

To predict the persistence of TSS elevation above background, an analysis of the percentage of time TSS is expected to be greater than indicative threshold concentrations was carried out. This was done for each season for threshold concentrations of 5, 25 and 50mgL$^{-1}$. The results are displayed in Figure 5-6 to Figure 5-14.

These figures show that it is expected that TSS in the harbour, entrance channel, South and South-West Creek will exceed 5mgL$^{-1}$ at least 75% of the time. The threshold level of 25mgL$^{-1}$ is expected to be exceeded up to 60% of the time in some areas of the harbour and the area bordering the spit, and up to 100% of the time adjacent to the tailwater discharge locations. The 50mgL$^{-1}$ threshold value is exceeded less than 20% of the time in most areas of the harbour, entrance and creeks, except in the area adjacent to the tailwater discharge locations.

At the tailwater discharge locations, the water is discharged into essentially dry ground during low tide, so the particles have a high potential to settle out, and are then able to be resuspended at high tide. This causes a build-up of sediments during the discharge process, and therefore high exceedence values.

In summary, it is predicted that TSS in South-West and South creeks and the area adjacent to the spit at the harbour mouth will be elevated above background levels during reclamation. Once the reclamation process has been completed these levels are expected to decrease rapidly over a few tidal cycles.

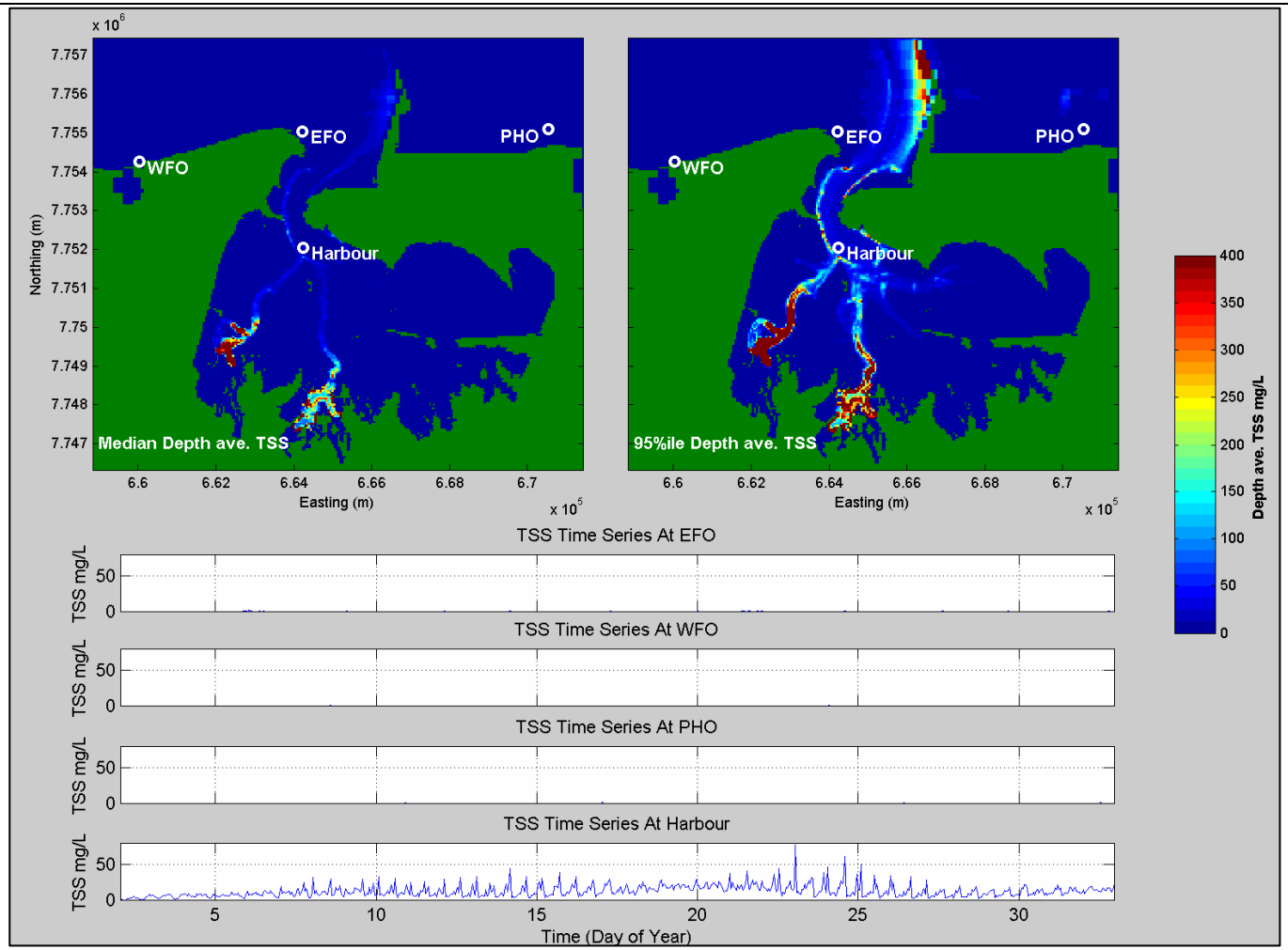


**Figure 5-3 TSS median, maximum and time-series plots for Scenario 1, Summer**

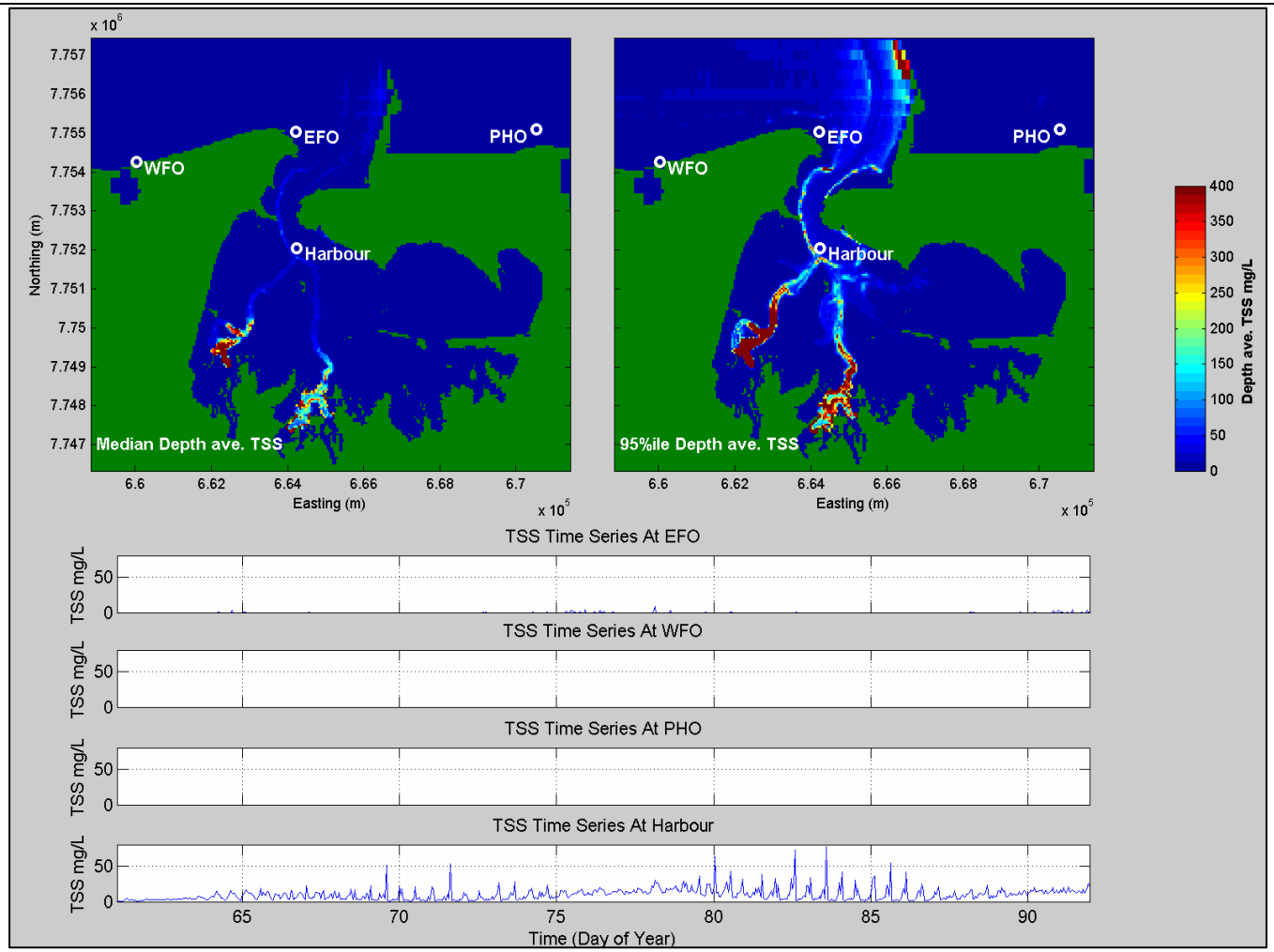


**Figure 5-4 TSS median, maximum and time-series plots for Scenario 2, Transition**

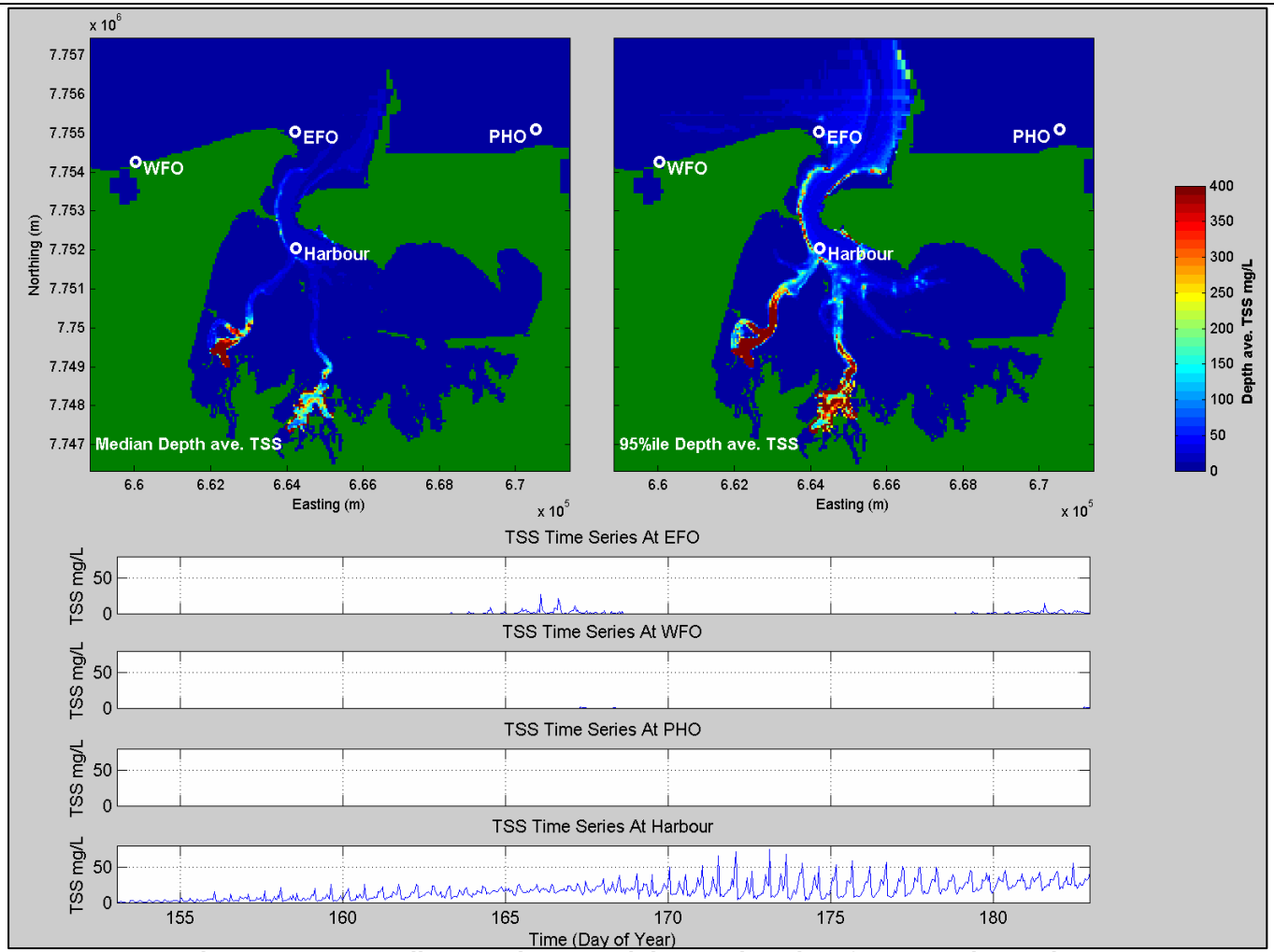


**Figure 5-5 TSS median, maximum and time-series plots for Scenario 3, Winter**

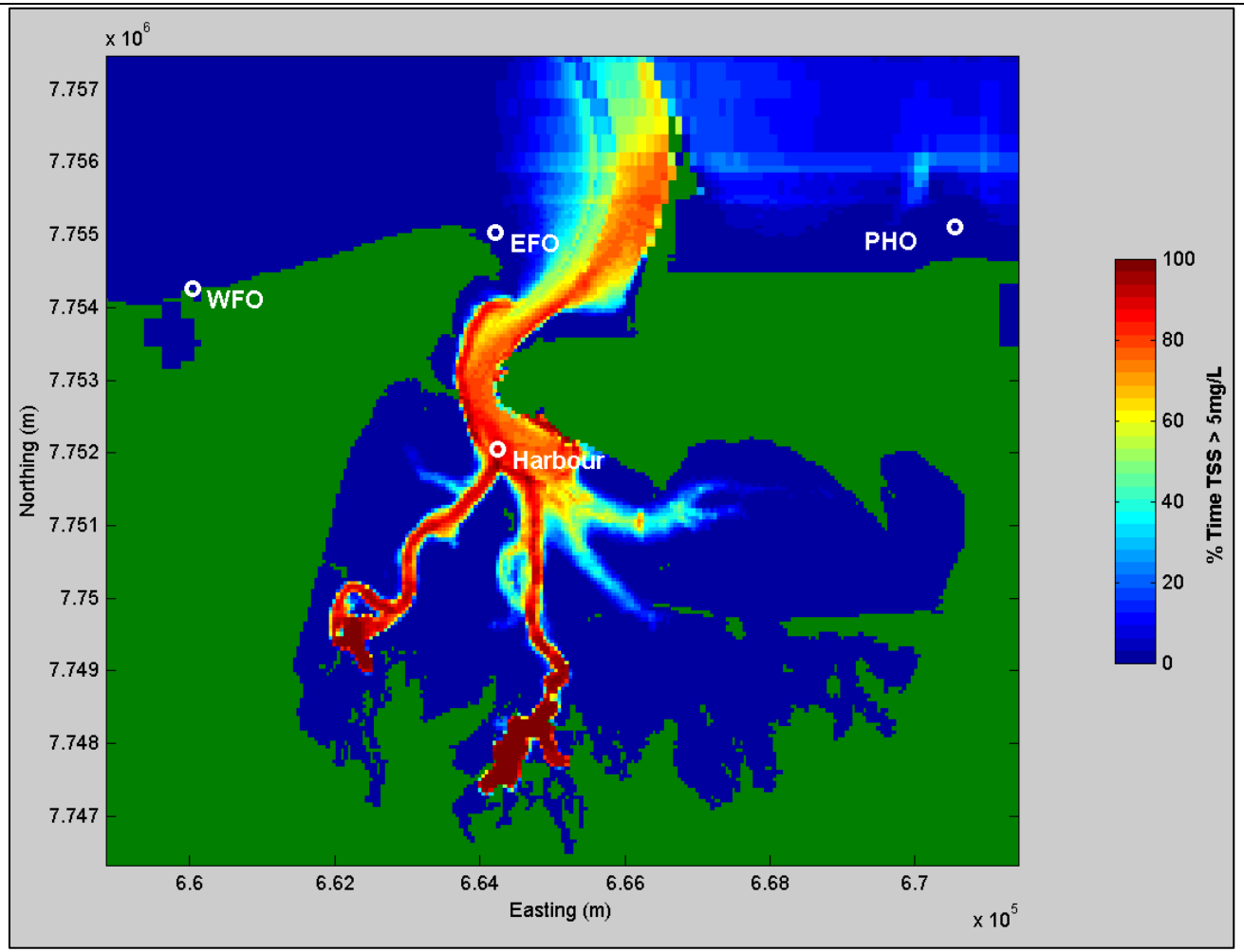


**Figure 5-6 Summer % time exceedence of TSS elevation above background for threshold level 5mgL$^{-1}$**

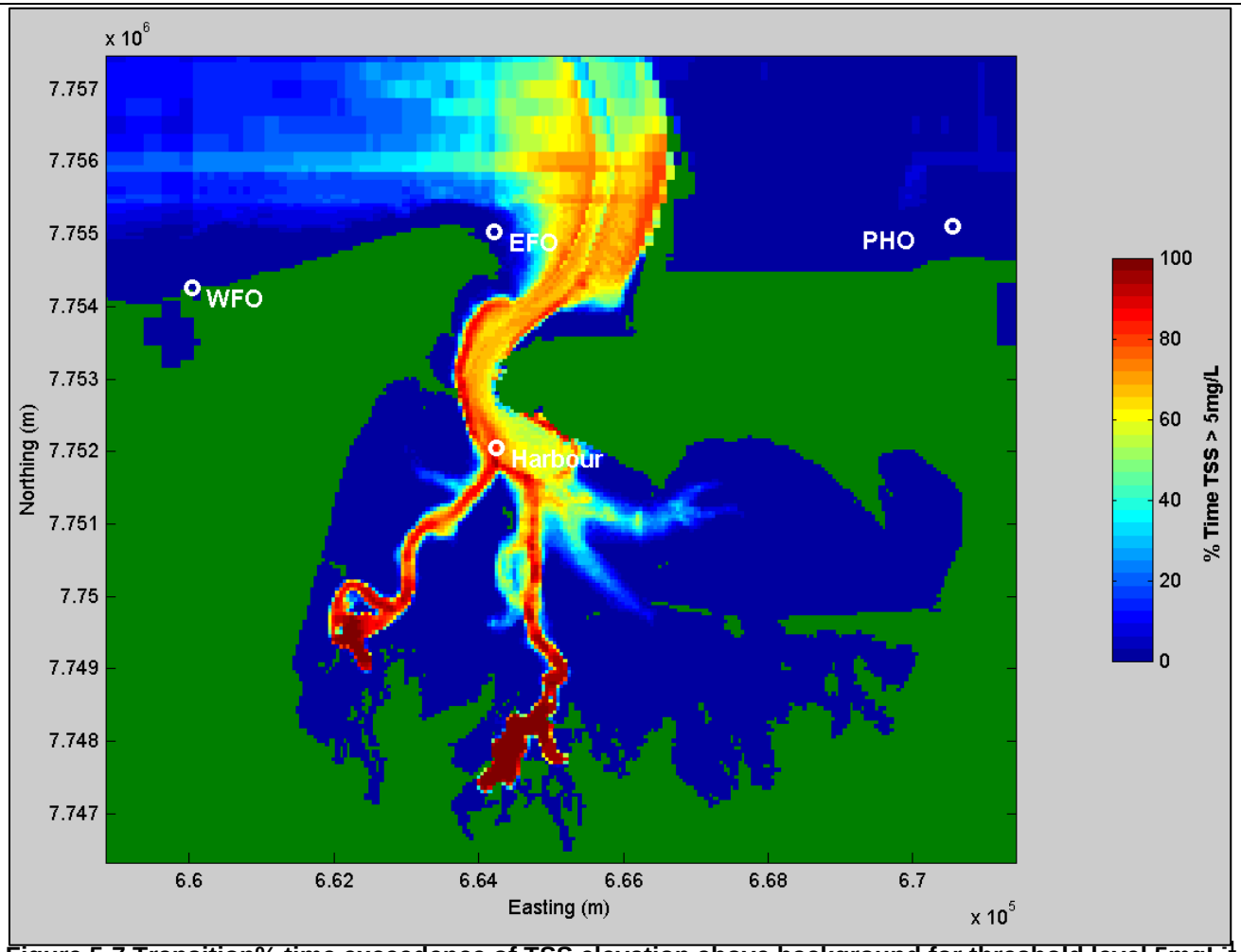


**Figure 5-7 Transition% time exceedence of TSS elevation above background for threshold level 5mgL$^{-1}$**

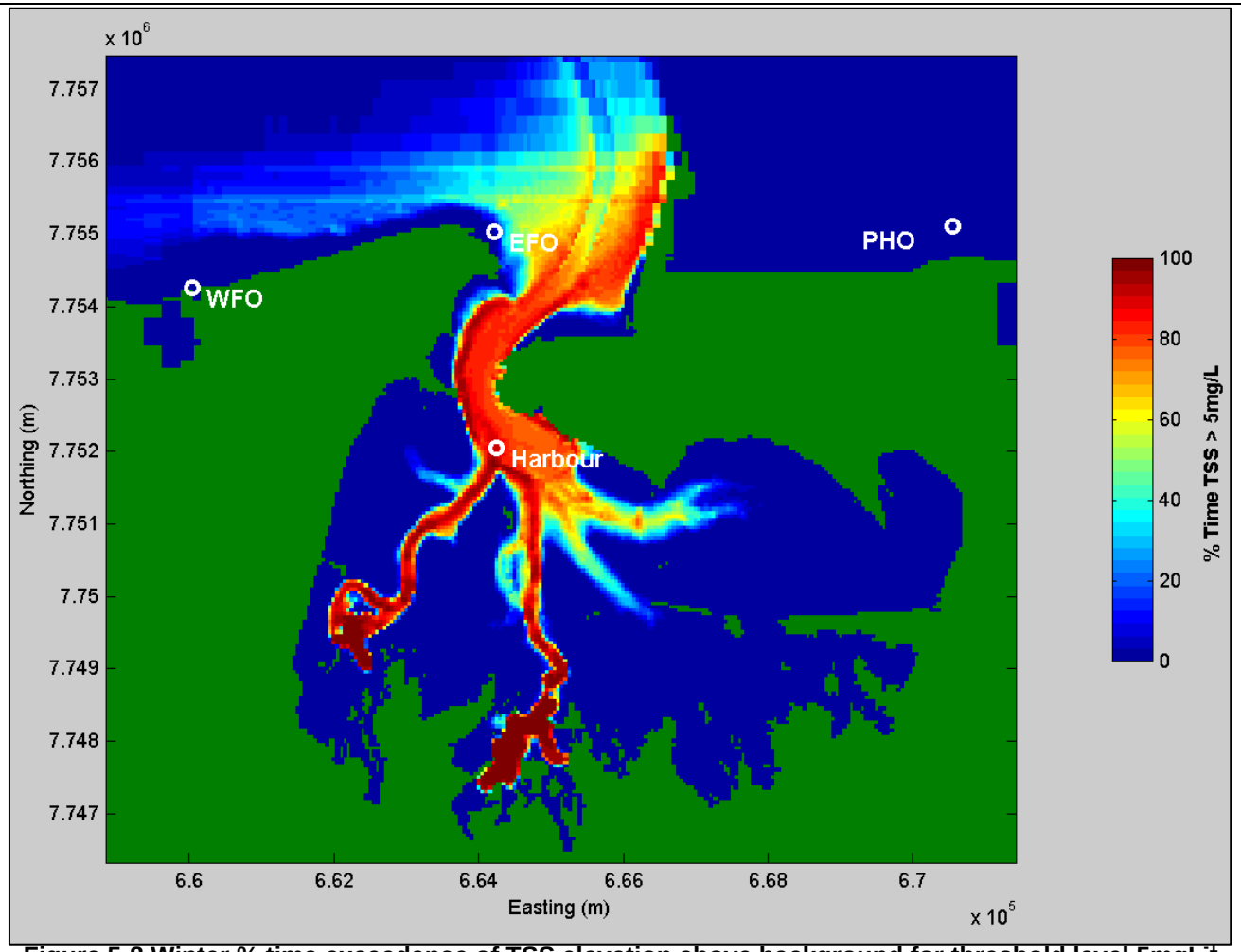


**Figure 5-8 Winter % time exceedence of TSS elevation above background for threshold level 5mgL$^{-1}$**

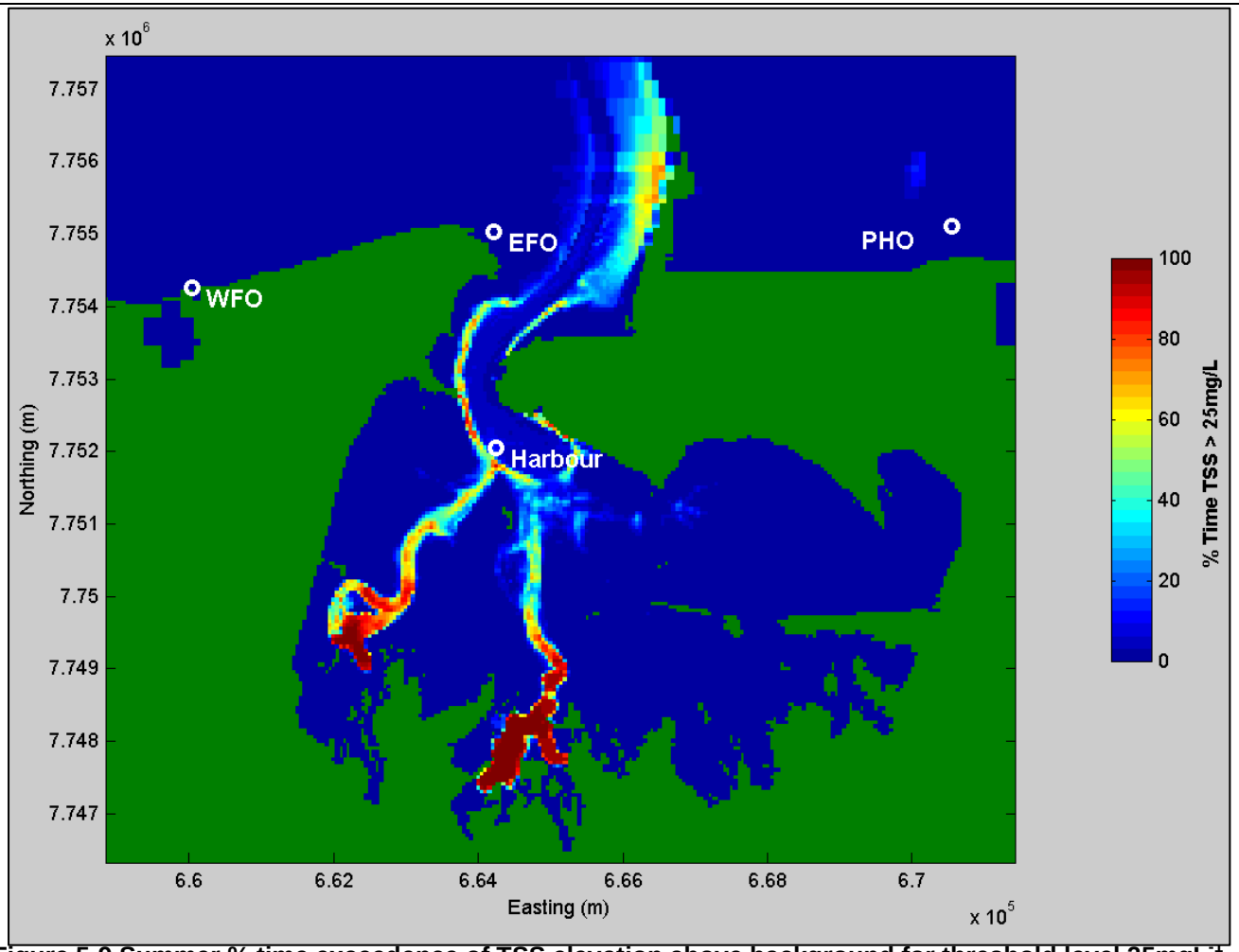


**Figure 5-9 Summer % time exceedence of TSS elevation above background for threshold level 25mgL$^{-1}$**

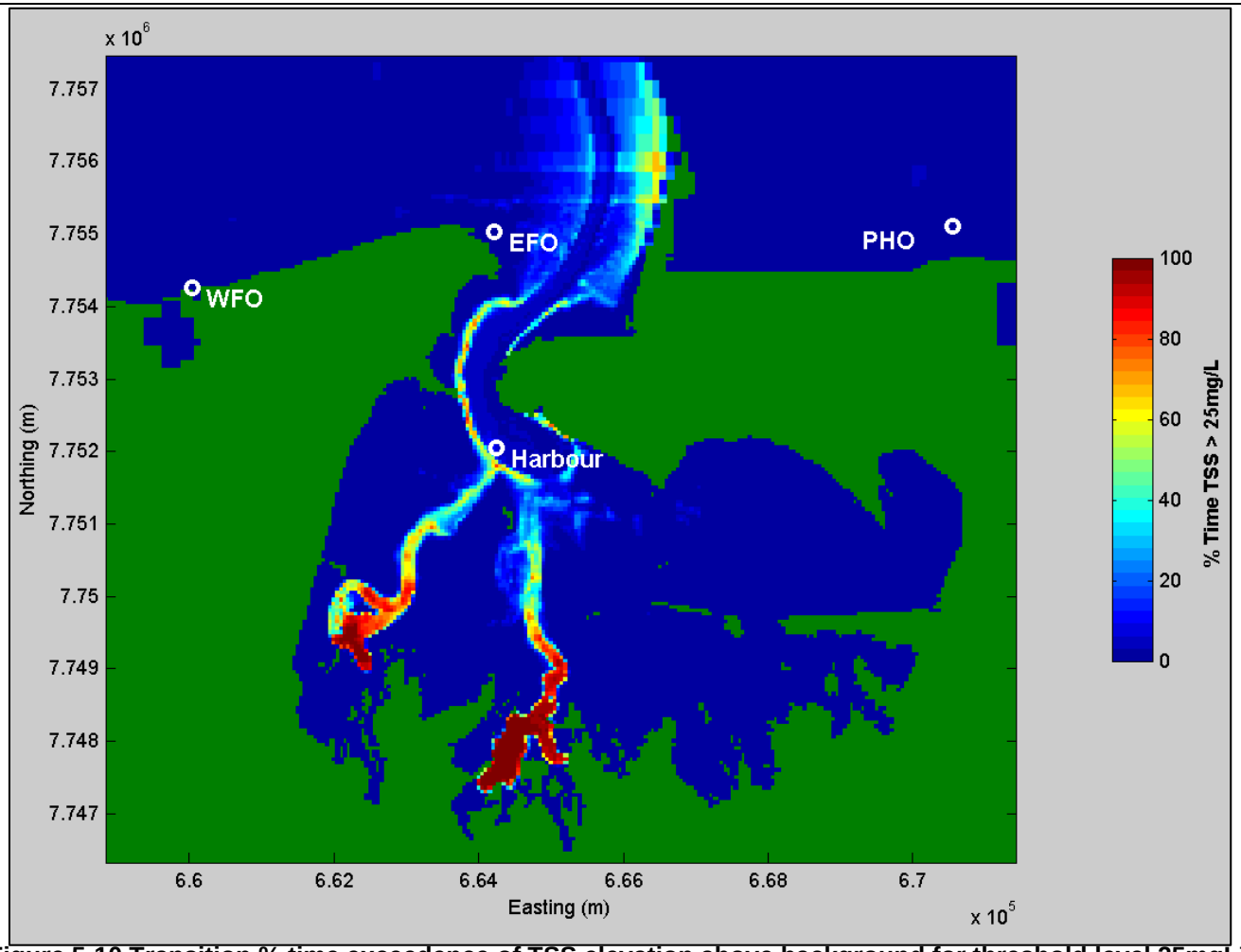


**Figure 5-10 Transition % time exceedence of TSS elevation above background for threshold level 25mgL$^{-1}$**

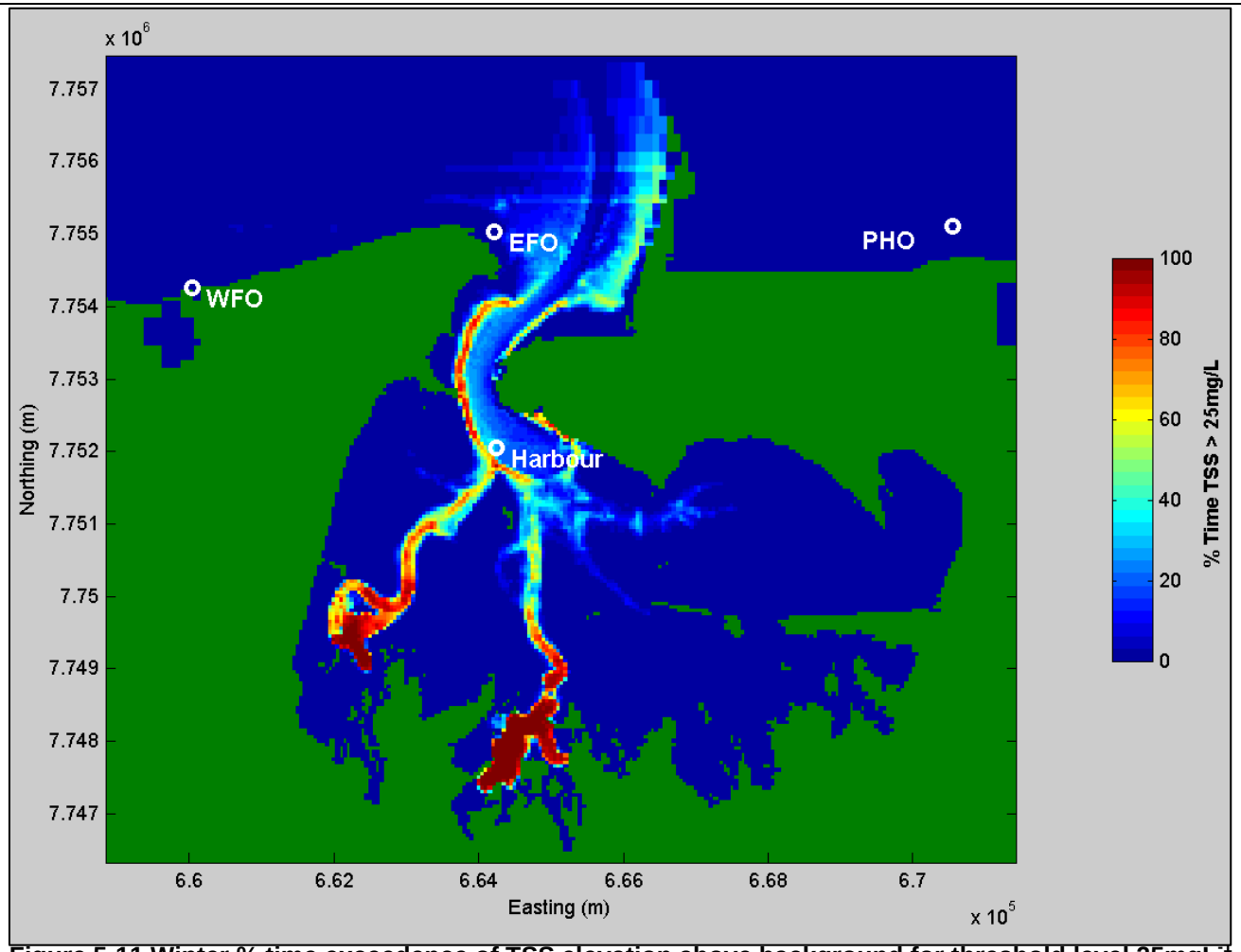


**Figure 5-11 Winter % time exceedence of TSS elevation above background for threshold level 25mgL$^{-1}$**

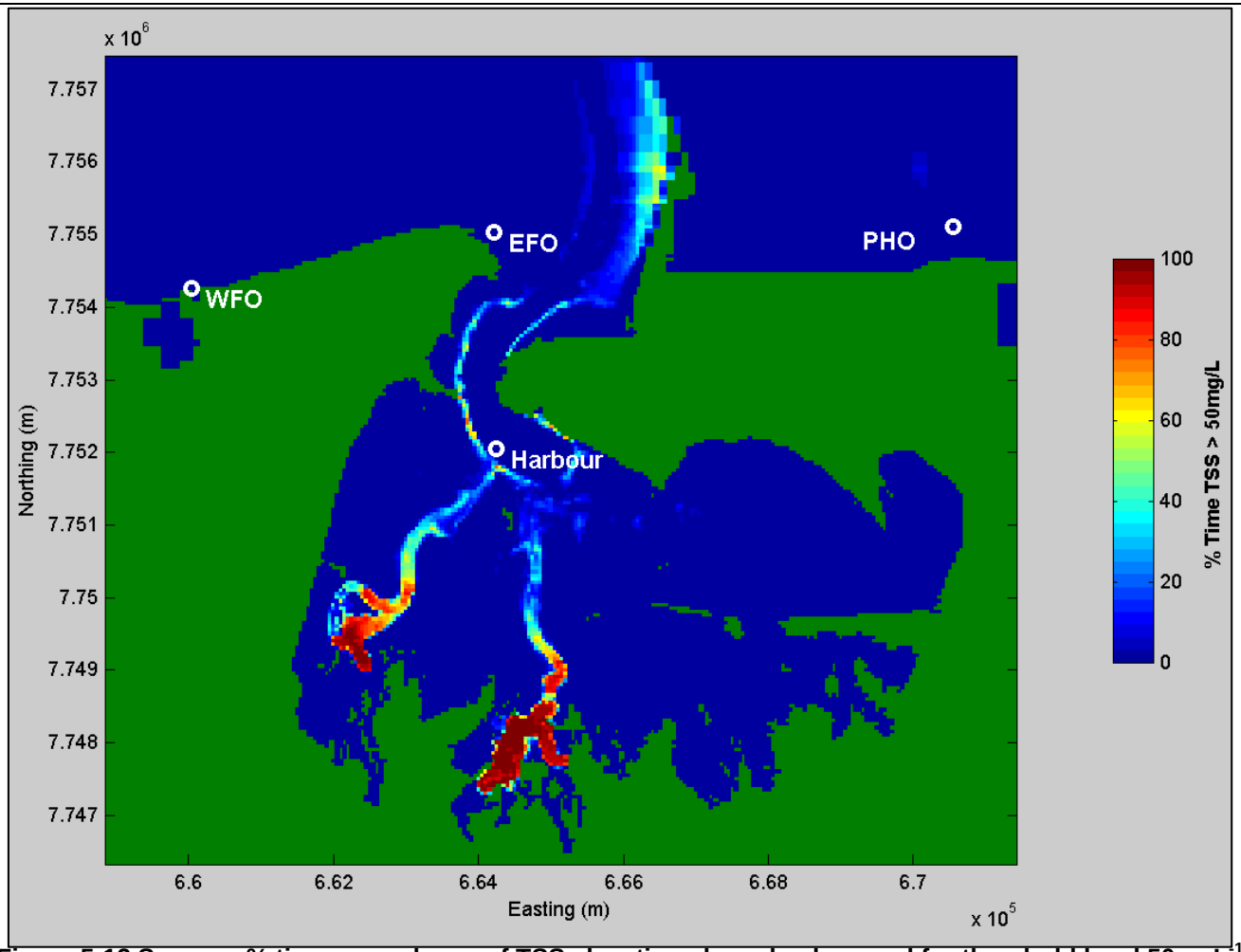


**Figure 5-12 Summer % time exceedence of TSS elevation above background for threshold level 50mgL$^{-1}$**

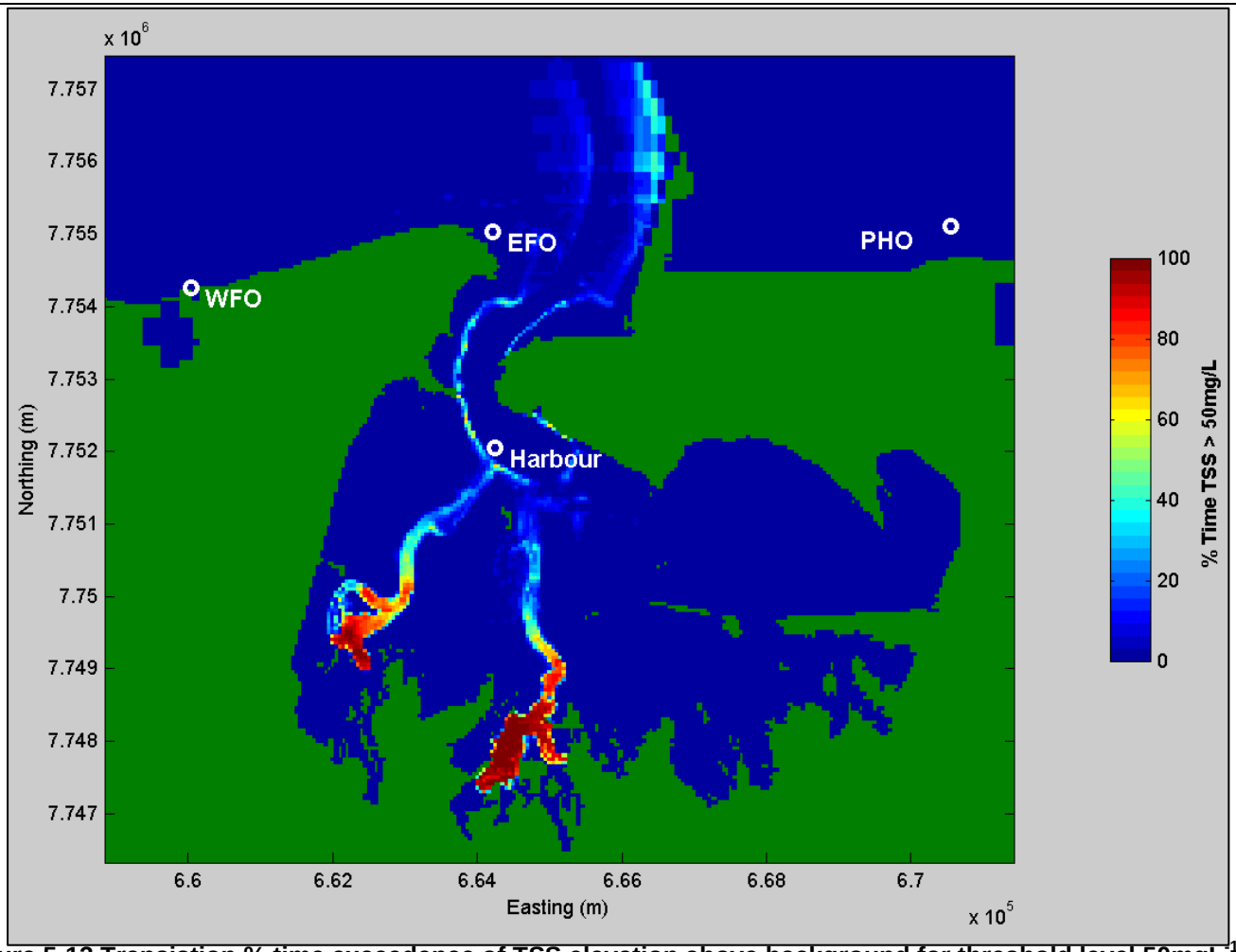


**Figure 5-13 Transistion % time exceedence of TSS elevation above background for threshold level 50mgL$^{-1}$**

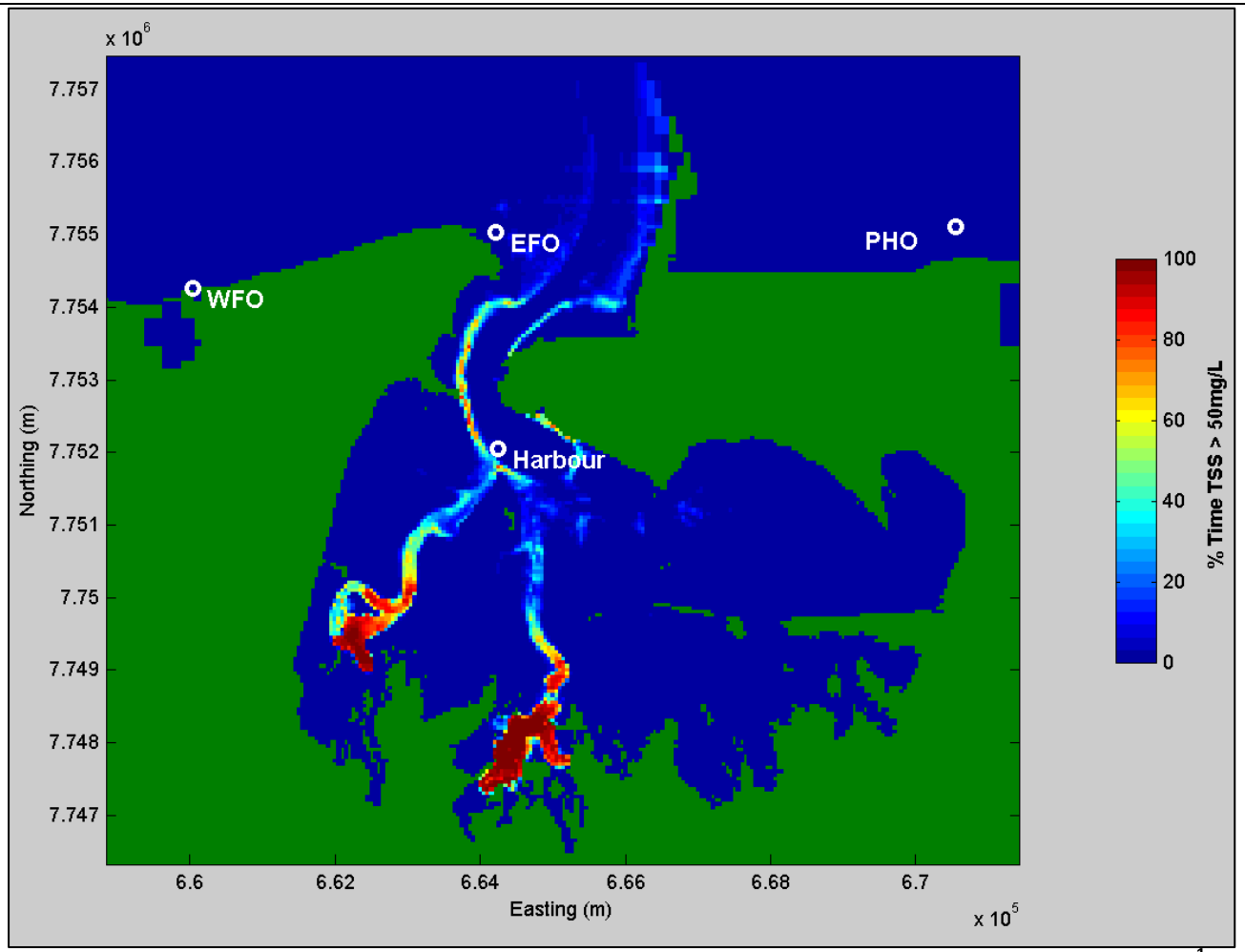


**Figure 5-14 Winter % time exceedence of TSS elevation above background for threshold level 50mgL$^{-1}$**

# 6. SUMMARY AND CONCLUSIONS

As a result of the dispersion study the following conclusions can be made:

- The dredging and reclamation is unlikely to have any significant effect at coral bommie sites WFO and PHO.
- During the summer and transition periods, a very minor increase in suspended sediment concentration at EFO is predicted due to the reclamation and dredging program.
- During the winter period, it is likely that the circulation due to the wind conditions would result in an increase in suspended sediment concentration at EFO of up to 20mgL$^{-1}$ from the dredging and tailwater discharge.
- The tailwater discharge is predicted to cause an increase in suspended sediment concentration in South-West and South Creeks, and in the area immediately to the west of the spit at the mouth of the harbour. This is expected to dissipate after the dredging/reclamation program is complete.

It is recommended that the turbidity is closely monitored throughout the dredging/reclamation program.

# 7. REFERENCES

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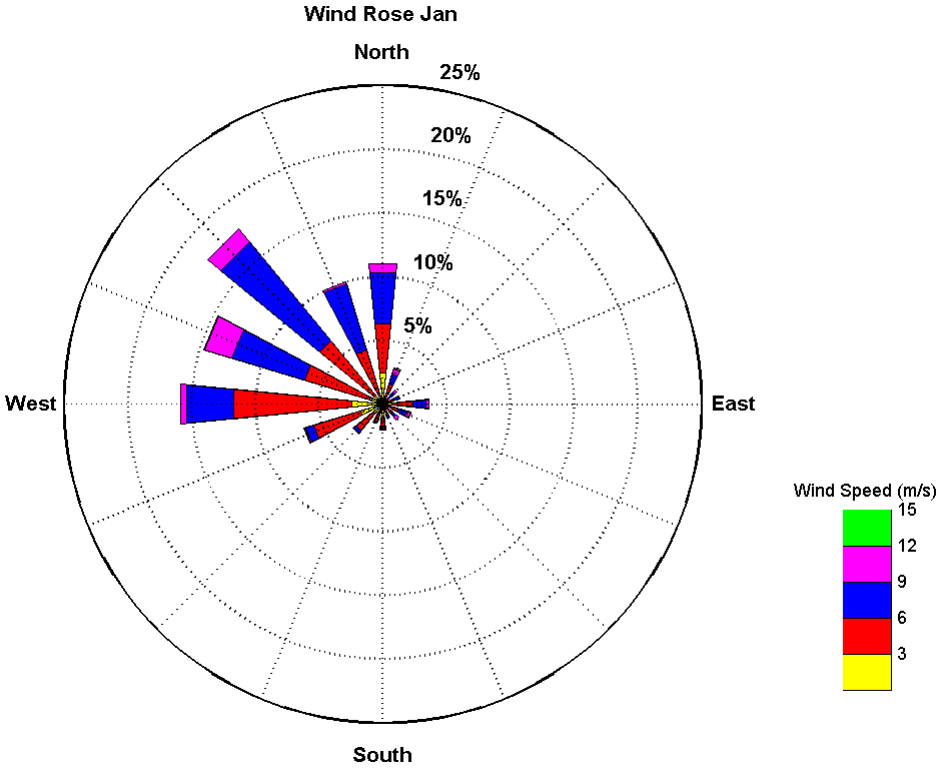
# Appendix A – Wind Roses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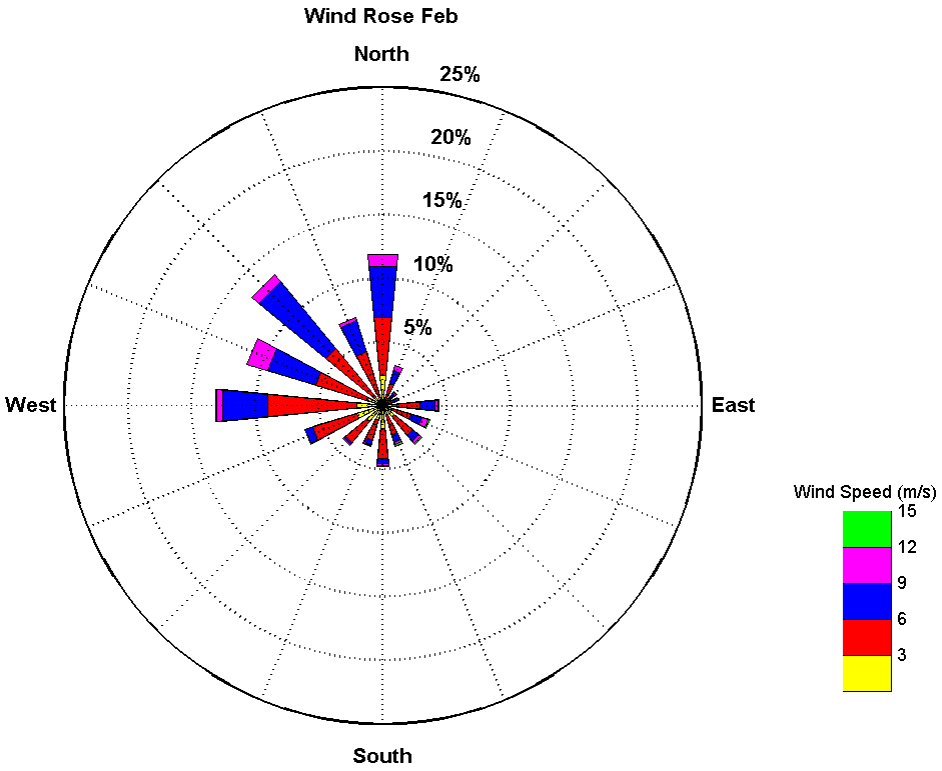
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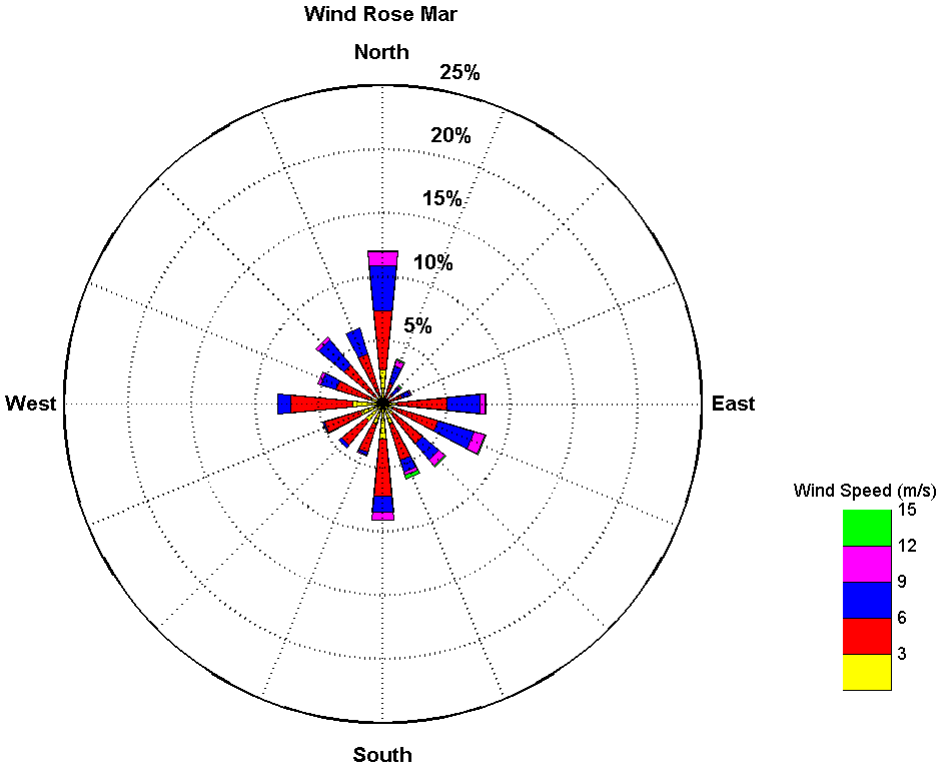
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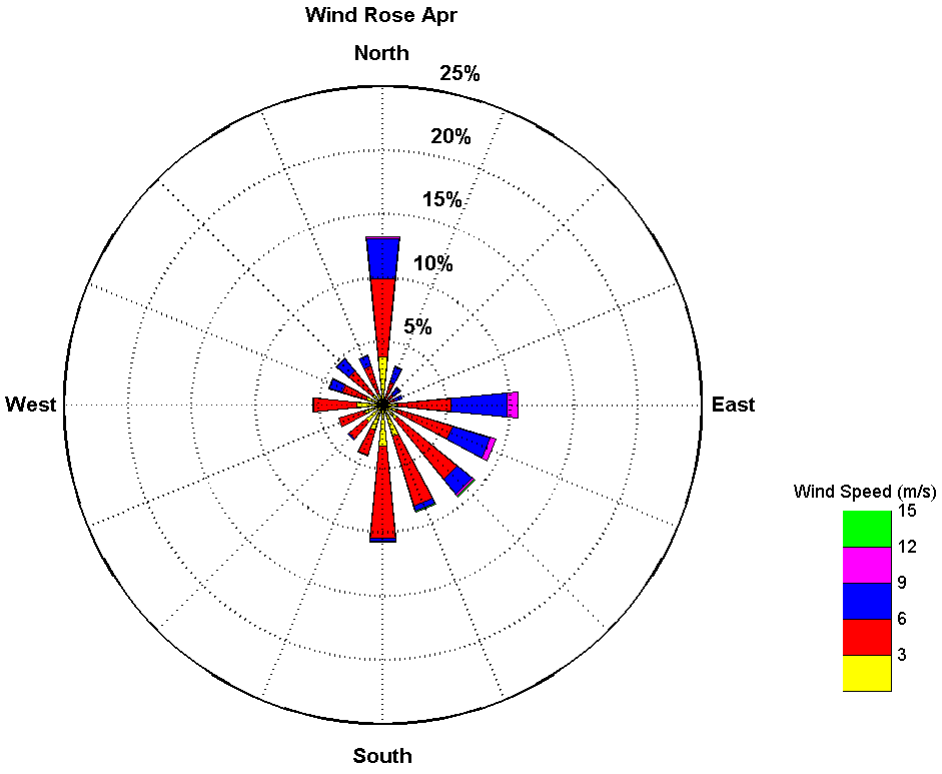
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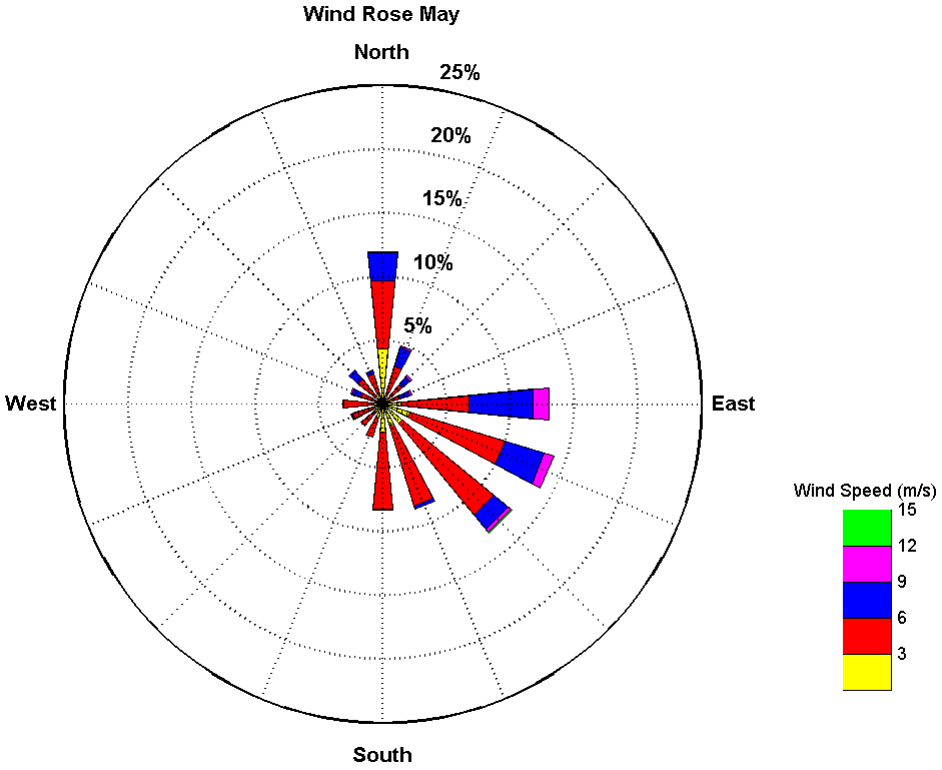
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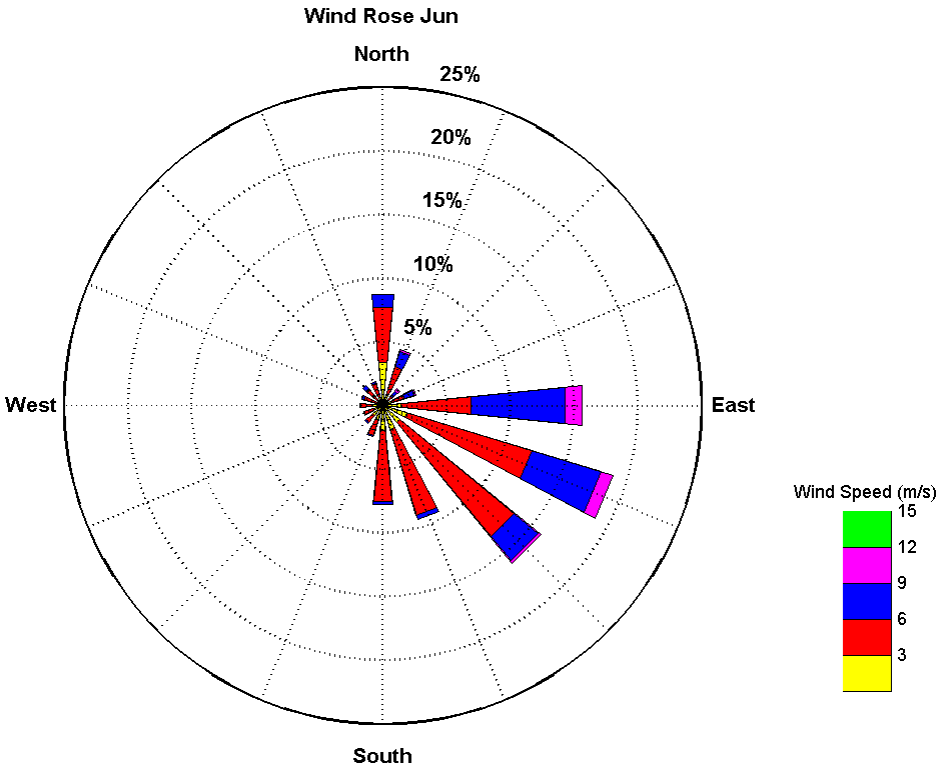
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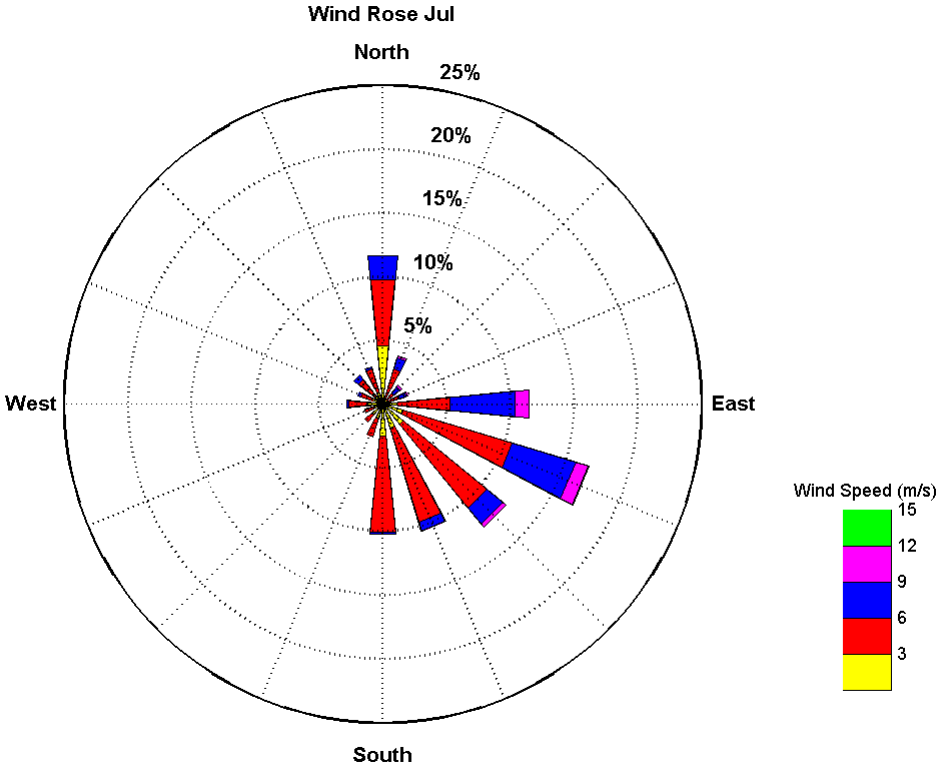
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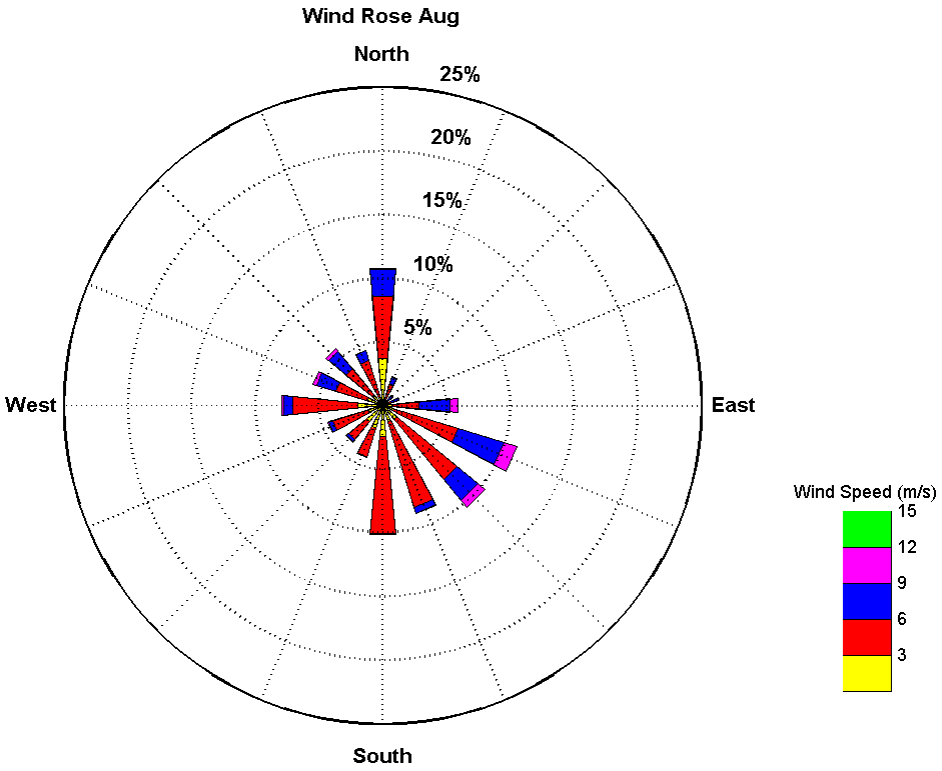
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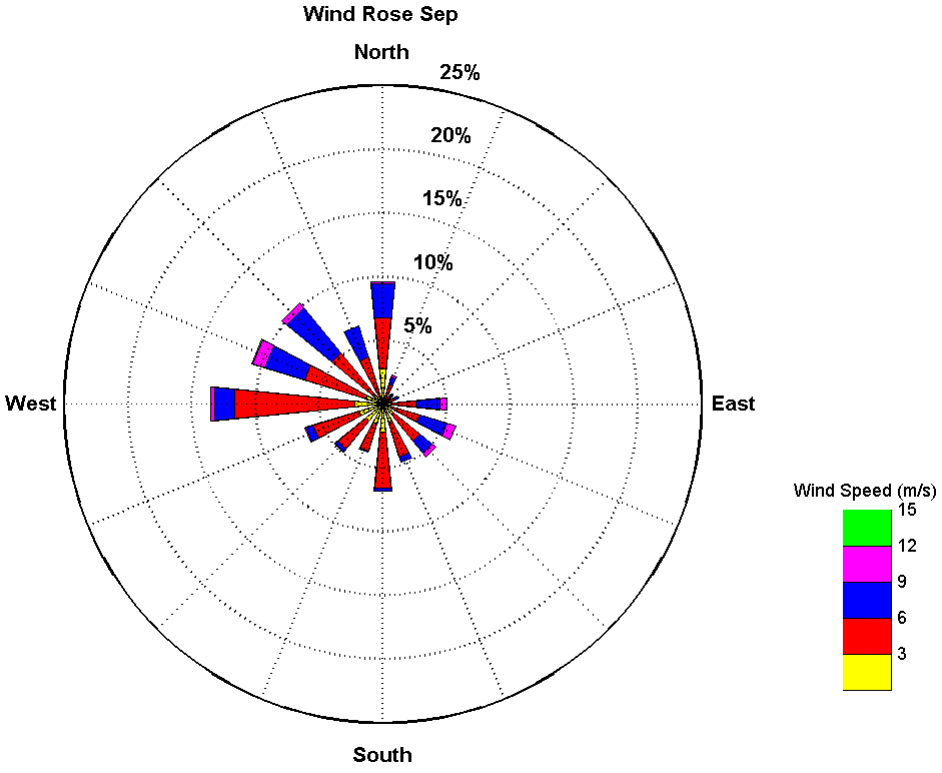
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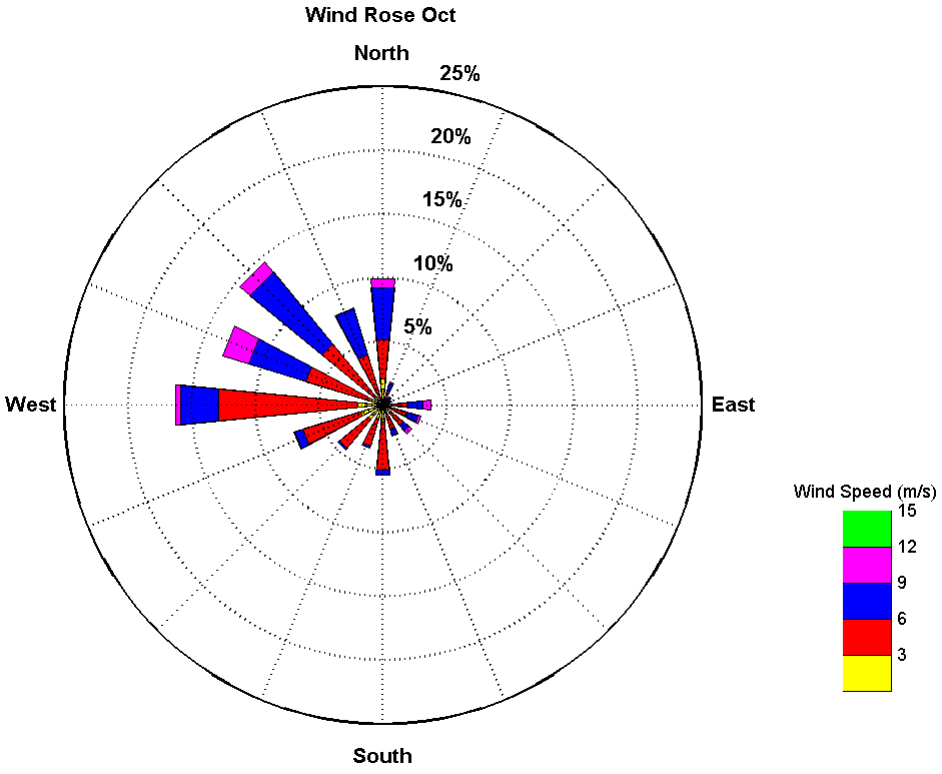
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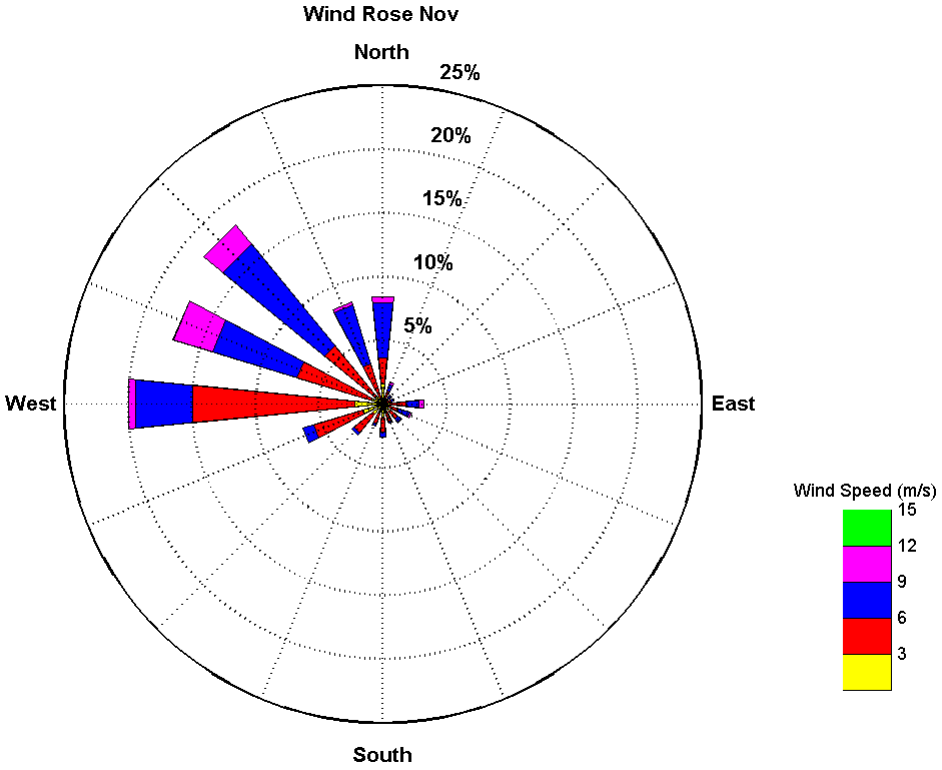
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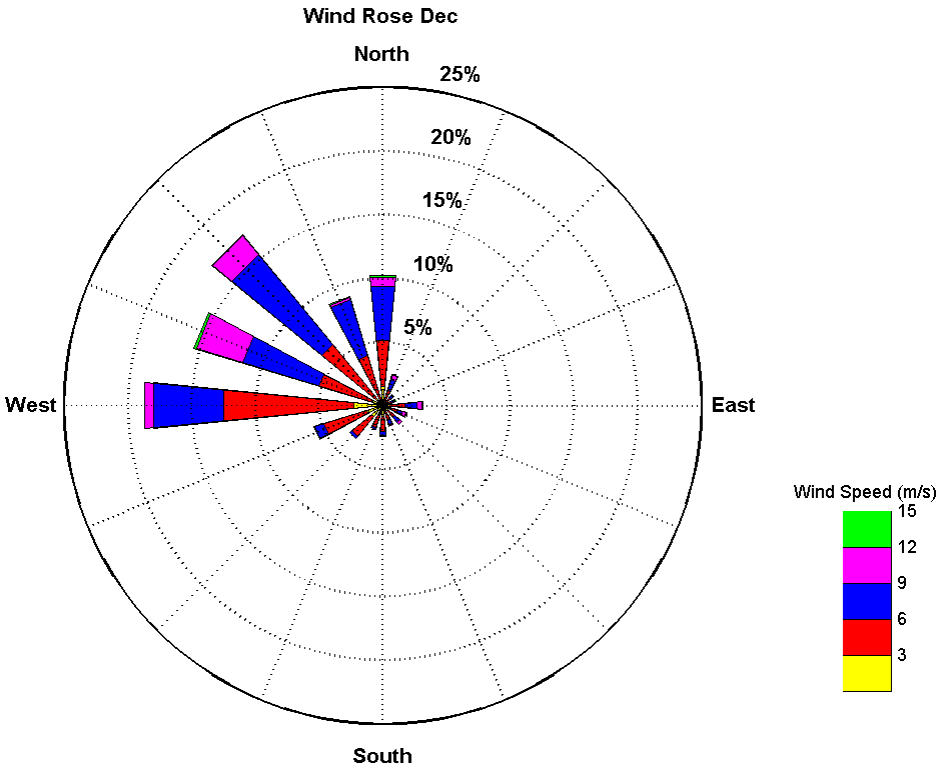
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# Appendix C

# Record of Consultation with Mulga Downs Partnership

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**Record of Communications Between FMG and Mulga Downs – March 2003 to October 2005**

| Date | Content of Communication |
|---|---|
| Undated but around 5/03/04 | Letter from Steve Hooson outlining Mulga Downs Partnership's (MDP) consent under conditions for FMG to carry out test drilling on Mulga Downs Station |
| 19/03/04 | Letter from Jim Williams to Steve Hooson agreeing to the above conditions |
| 6/04/04 | Meeting b/n Steve and Marlene Hooson (MDP station managers) and FMG's Kylie Jones. Discussed the proposal and weather or not FMG could construct an access track. Approval given |
| 6/05/04 | Meeting between Steve and Marlene Hooson (MDP) and Kylie Jones and David Forrest (FMG). Steve and Marlene reiterated that they had no issue with either the proposed mine or access track. Steve expressed interest in gaining the contract to construct the access track. |
| 14/05/04 | Letter to Steve and Marlene Hooson from Kylie Jones. Also provided a map of the discussed access track, and acknowledged Steve's expression of interest for the contract to construct. |
| 29/07/04 | Eamon Hannon and Stuart Robinson (from FMG) meet with Ken Rick (new MDP station manager) in regards to plans to embark on drilling of the Cloudbreak and White Knight prospects. Ken expressed interest in carrying out clearing if he has a machine and operator available. |
| 29/09/04 | Stuart Robinson, Kylie Jones, and David Forrest (FMG) meet with Ken Rick (MDP). Stuart presented Ken with a CD showing landsat imagery of the Cloudbreak and White Knight area overlaying the Mulga Downs pastoral lease. FMG agreed to get Ken to carry out the clearing as long as he had the time and equipment available |
| 25/10/04 | Fax from Kylie Jones to Ken and Danielle Rick informing of a planed flora survey. Provided a map of the planed survey, and asked if it would have any affect on station management. |
| 18/11/04 | Meeting with Ken Rick and Stuart Robinson and Eamon Hannon. Discussed:<br>• Condition of the track accessing the Cloudbreak prospect. FMG agreed to carry out restoration work on completion.<br>• Water usage and monitoring<br>• Further information on planned drilling<br>• Potential for Mulga downs to supply a backhoe to install Cloudbreak septic sump |

| Date | Content of Communication |
|---|---|
| 8/03/05 | Letter sent from Kylie Jones to Ken and Danielle Rick announcing FMG's hydrogeological study. Attached was a sheet for signing and returning if approved. |
| 21/03/05 | MDP return faxed signed approval for groundwater investigation, on condition that it won't affect stock watering points. |
| 29/03/05 | Meeting between Stuart Robinson, Eamon Hannon and Doug Kepert from FMG and Ken Rick:<br>• Discussed hydrogeological study |
| 5/05/05 | Meeting with Stuart Robinson and Ken Rick:<br>• Discussed mustering program<br>• Discussed drilling program<br>• FMG Committed to repairing access tracks prior to mustering. Invited Ken to direct to the standard required |
| 15/05/05 | Meeting between Stuart Robinson and Ken Rick |
| 11/07/05 | Letter to Mulga Downs Station providing a copy of the Cloud Break Scoping Document. |
| 10/08/05 | Meeting between Stuart Robinson and Dave Mendelawitz from FMG and Ken Rick |
| 5/09/05 | Meeting between Stuart Robinson and Ken Rick:<br>• FMG hand delivered a letter informing MDP of FMG's intention to trial mine |
| 12/09/05 | FMG wrote to MDP in order to inform them of the release of the Cloudbreak PER |
| 16/09/05 | Letter sent by Barry Walsh (MDP manager) to Stuart Robinson (FMG) acknowledging receipt of letter given on 5/09/05, and requesting FMG to contact HPPL (Hancock Prospecting Proprietary limited) about the proposal. FMG could not find any record of this, and consequently contacted HPPL to resend the letter after a subsequent letter was received on 3/10/05. HPPL did refax this letter on 12/10/05. However, the following day FMG received a fax from HPPL saying the previous days fax was sent in error, please destroy. |
| 3/10/05 | Peter Fisher (Manager Projects, HPPL) sent Graeme Rowley a letter, repeating the content of the letter dated 16/09/05. |
| 4/10/05 | Stuart Robinson met with Ken Rick on-site. Mr Rick explained that Perth Management was taking control of all matters between MDP and FMG. |

| Date | Content of Communication |
|---|---|
| 12/10/05 | FMG contacted the HPPL office to request that the letter dated 16/09/05 be resent. The letter was resent along with the letter of 3/10/05 |
| 13/10/05 | Peter Fisher (manager projects, HPPL ) sent a fax stating that the fax from the previous day was a mistake, and requesting FMG to destroy it. |
| 17/10/05 | Jim Williams (Head of Mining, FMG) sent a letter to Peter Fisher apologising for FMG's tardiness in responding and addressing the concerns raised in the letters dated 16/09/05, and 3/10/05. |
| 20/10/05 | Barry Walsh sent Graeme Rowley a letter asking for confirmation of FMG's received approvals and compliance there-of, and stated that MDP did not give permission for trial mining, or increasing the size of the airstrip at Moojarri Well. |
| 25/10/05 | Julian Tapp (Head of Special Projects, FMG) tried to call Peter Fisher to discuss MDP and HPPL's concerns. After not being able to contact Peter, Julian wrote an email requesting a meeting. |
| 26/10/05 | After receiving no reply, Julian Tapp sent Peter Fisher another email requesting a meeting. To date FMG has received no reply to these last 2 communications. |
| 27/10/05 | Stuart Robinson sent an internal Memo covering informal discussions held with Ken Rick, the Mulga Downs station manager during August, September and October (up to the point when Ken was directed to no longer talk to FMG). These discussions covered mainly FMG's desire to lengthen the airstrip at Moojarri Well, and the creation of a new camp to cater for trial mining. |
| 04/11/05 | Diane Dowdell sent a letter to Barry Walsh highlighting that FMG was aware of the concerns that Mulga Downs Partnership had raised in their submission and would be willing to meet with Mulga Downs at a time and place convenient to them. |
| 07/11/05 | Julian Tapp sent a letter to Peter Fisher responding to their concerns over FMG's operations on Mulga Downs Station and offering to meet with HPPL and Mulga Downs. |
| 9/11/05 | Letter to Richard Parquay of HPPL regarding access to rail infrastructure to be constructed and operated by FMG. This letter was in response to a letter from Mr Parquay asking for terms of access to FMG's rail. This letter outlined previous non-responses from HPPL and Mrs Rinehardt regarding this issue dating back over 2 years and the current lack of contact from HPPL and Mulga Downs to meet and resolve issues. |

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# Appendix D

# Cloud Break Consultation Process

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**CLOUD BREAK PER**

**COMMUNITY CONSULTATION PROCESS**

The following consultation process was undertaken by the Fortescue Metals Group Ltd (Fortescue) Environment team for the Cloud Break Public Environmental Review (PER). The process was conducted in accordance with Fortescue's Community Consultation Strategy (Appendix 1).

**Identification of Key Stakeholders**

Stakeholders were identified at the outset of the process. Two methods were used for identification:

1. Government mapping information: including DLI Cadastre maps; Department of Industry and Resources Ten Graph maps.

   These maps were used to identify lands which would be affected by the Pilbara Iron Ore and Infrastructure Project – this included Pastoralists and Native Title Claimant groups.

2. Knowledge of existing community stakeholder or interest parties.

   This included Local Shires, State Government Agencies, Environment and other relevant Community groups.

**Information Governance**

Records of these relevant Stakeholders, contact names, contact numbers/addresses were added onto the database and a stakeholder list was compiled (Appendix 2). The method by which stakeholders were contacted was also recorded on the database (e.g. Personal Visit, letter).

**Contacting Stakeholders**

In July 2005, Fortescue corresponded with a range of key stakeholders to advise that a Public Environmental Review report was being prepared for Cloud Break (Appendix 3). The letter included a copy of the proposed mining area as well as a scoping document which briefly outlined the project. An invitation to meet with the company was issued as part of this letter.

On 12 September, 2005 the stakeholders identified in Appendix 2 were again contacted by letter to announce the release of the company's PER for the "Cloud Break Iron Ore Mine – No Beneficiation".

The letter clearly identified the public comment review period for the PER and included an invitation to meet with company representatives to discuss any issues and concerns (Appendix 4).

Several key Stakeholders were also contacted personally to understand and address particular issues.

Furthermore, a field trip to the proposed Cloud Break site was organized by Fortescue to assist interested stakeholders in responding to the PER. This reflected Fortescue's intention to make the consultation process open and transparent. Several of the interested Stakeholder groups took up this offer.

These groups were:

- Town of Port Hedland
- Care For Hedland Group
- Department of Industry and Resources (DoIR)
- CALM
- Conservation Council of Western Australia (CCWA)

In addition, to those who participated, the following stakeholders were also invited but unable to attend:

- Department of Environment (DoE)
- Shire of East Pilbara
- Shire of Ashburton
- Birds Australia

**Managing Issues**

We are now in the final stages of the PER process. Stakeholder submissions have been returned directly to the DoE. These have since been forwarded to Fortescue for response. Fortescue is currently responding to these submissions directly and will return them to the DoE for their assessment.

## Appendix 1

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# FMG Community Consultation Strategy

## 1 Introduction

As part of the Fortescue Metals Group Limited (Fortescue) Project in the Pilbara region of Western Australia, the following strategy guides our Community Consultation processes.

- Identification of Stakeholders
- Individual Plans In Response
- Managing Issues

## 2 Identifying Stakeholders

At the outset of any Community Consultation process, identification of the key Stakeholders is conducted (this will vary dependent on the type of consultation proposed). The following areas are considered when identifying the relevant Stakeholders:

- Scope of process – is it information only or a truly consultative process?;
- Sphere of interest – how extensive is the awareness or concern regarding the issue to be discussed?;
- Physical location - is it in a township, station, Indigenous Community?; and
- Method of delivery - how the information is to be delivered and discussed based on the needs of the relevant groups.

FMG has developed a central database to manage all of the contact details for interested and involved stakeholders and community members and this information is utilised by the Company for all consultation processes. For any community consultation process the names, addresses, and contact details for individuals are compiled from the central database. It is our intention that the progression through the Consultation process is as transparent in nature as are the Stakeholders who are being consulted.

The Community Relations Co-coordinator is the “owner” of the database and is responsible for ensuring that the database is kept up-to-date at all times. This will ensure information is stored and recorded consistently and will meet the needs of FMG to effectively engage with community members and key stakeholders.

### *2.1 Information Governance*

An electronic folder for all Stakeholders is created at the commencement of a consultation process and the information contained is shared within the

Company. All written correspondence or information relevant to this Stakeholder is also stored in this folder using existing document management protocols. A log of the date that any correspondence was physically sent, the method (e.g. post/courier) is kept up-to-date by all individuals using this information. In addition, a log with any responses from key Stakeholders is stored on the database, including a log of telephone conversations containing the date of the call, a record of what was discussed and any issues raised.

### *2.2 Back Up Processes*

As the majority of the information is stored electronically, regular weekly back-up of the database is maintained to ensure that there is no loss of data or information.

## 3 Plan for Contacting Stakeholders

The following procedure is used when contacting Stakeholders:

- Information relevant to the scope, purpose or intent of the consultation is identified. This information would initially be sent out in writing either by letter or email.
- In some instances, in person may be the first point of contact for some of the remote Aboriginal Communities. Prior permission may need to be sought in these cases before visiting and relevant protocol is followed.
- If practical, a follow-up call is made either by phone or in person. This ensures that the information has been received and encourages a first response to any initial queries.
- Forum for consultation – this depends on the nature of the consultation process required. It may be through correspondence or personal meetings. It may even require a mixture of the two. Alternately, a Consultation Group Meeting may be required where the key Stakeholders attend and an open discussion takes place.

### *3.1 What Stakeholders will want to know*

- Relevant information.
- Process of response, format of how they need to respond with any objections and concerns.
- What influence the Stakeholders have over the issues and/or process.
- Deadline for responses from Stakeholders (30 days/or deadline set out in communication).
- Timeframe for how FMG will respond to any objections.
- How Stakeholders will be notified of the findings of the consultation process.

# 4 Managing Issues

FMG will deal with all issues raised through community consultation or by stakeholders in a timely and reasonable manner. The target is to respond to any correspondence, were possible, within 10 working days.

The intent of FMG is to always work in good faith and to come to a mutually acceptable outcome. Resolution of any issues/disputes will be negotiated between the relevant parties involved. Resolution will depend on the nature of the issue.

## *4.1 Submissions and Objections*

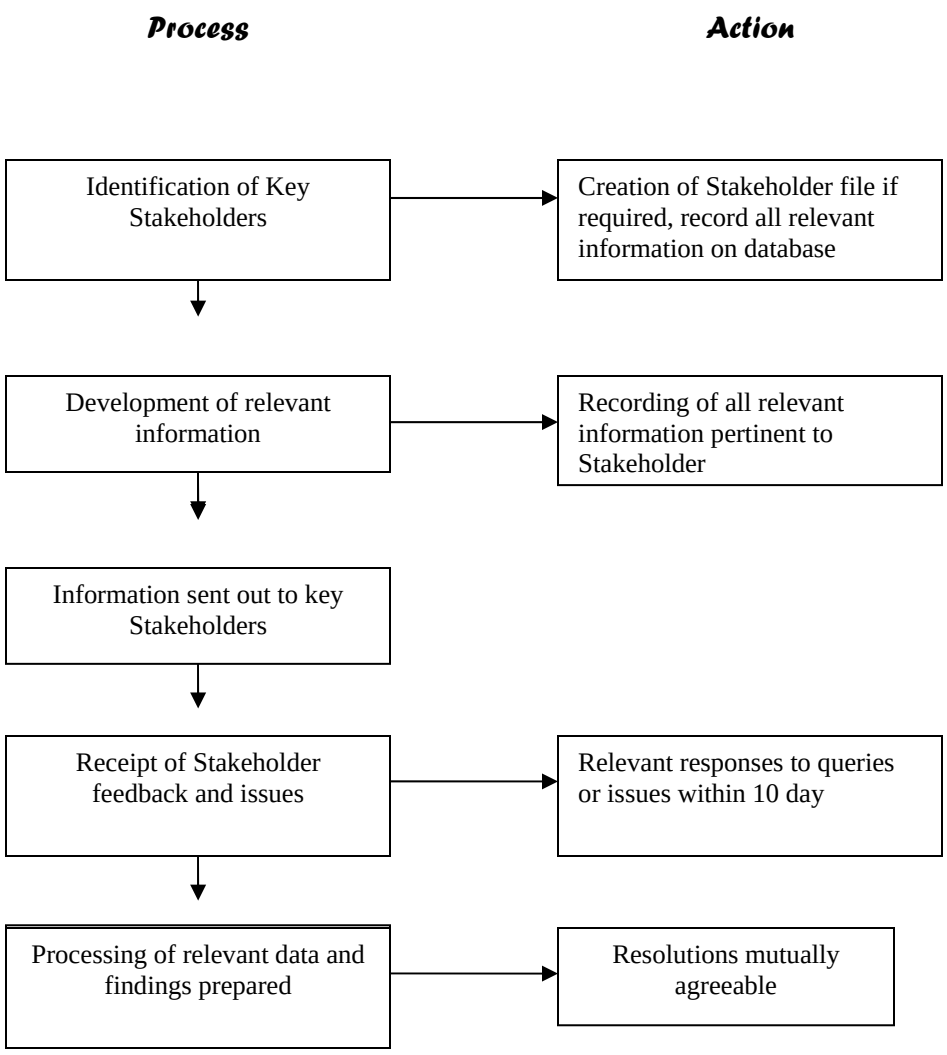
The process for logging any objections raised by Stakeholders is done in writing, outlining FMG's understanding of the issues they have raised. This is done either within 30 days of receipt of the communication, or alternatively within the deadline set out in the document submitted to them.

In certain instances, it may be necessary to conduct an additional public forum following receipt of submissions, but this will depend on the level and nature of responses received. It may take the form of interviews, surveys or follow up with community meetings based on feedback of Stakeholders.

## *4.2 Posting Of Information*

Following the Consultation Process, relevant information will be made public within 30 days, through:

- Publishing in document form;
- Distributing to the relevant key Stakeholders; or
- Findings may be published in the Media.


Process
Action
Identification of Key Stakeholders
Creation of Stakeholder file if required, record all relevant information on database
Development of relevant information
Recording of all relevant information pertinent to Stakeholder
Information sent out to key Stakeholders
Receipt of Stakeholder feedback and issues
Relevant responses to queries or issues within 10 day
Processing of relevant data and findings prepared
Resolutions mutually agreeable

## Appendix 2

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| Copy | First Name | Surname | Position | Company | Address | Town | State | Post Code |
|---|---|---|---|---|---|---|---|---|
| **Government Departments** | | | | | | | | |
| h | Neville | McInerney | | Ag WA | PO Box 651 | PORT HEDLAND | WA | 6721 |
| h | Stephen | White | Acting Regional Manager Pilbara Region | Department of Conservation and Land Management | PO Box 835 | KARRATHA | WA | 6714 |
| h | Stephen | Van Leeuwen | Research Scientist | Department of Conservation and Land Management | PO Box 835 | KARRATHA | WA | 6714 |
| h | Doug | Betts | Senior Environmental Officer Mining & Petroleum Assessment Branch | Department of Environment | Level 9, 141 St Georges Terrace | PERTH | WA | 6000 |
| h | Stephen | Hart | Natural Resource Management Officer | Department of Environment North West Regional Office | PO Box 836 | KARRATHA | WA | 6714 |
| h | Bruno | Rikli | Environmental Officer - Pilbara Region | Main Roads Western Australia | PO Box 2256 | SOUTH HEDLAND | WA | 6722 |
| h | Craig | Wilson | Environmental Engineer | Port Hedland Port Authority | PO Box 2 | PORT HEDLAND | WA | 6721 |
| h | Ian | Hutton | Chief Executive Officer | Port Hedland Port Authority | PO Box 2 | PORT HEDLAND | WA | 6721 |
| cd | Petrina | Raitt | Environmental Program Manager | Department of Environmental Protection (DEP) | PO Box K822 | PERTH | WA | 6842 |
| cd | Mark | Hewitt | Regional Manager | Department of Indigenous Affairs - Pilbara Region | PO Box 2634 | SOUTH HEDLAND | WA | 6722 |
| h | Susan | Worley | Manager | Department of Environment Water & Rivers Commission | Karratha Office PO Box 836 | KARRATHA | WA | 6714 |
| h | Robyn | Crane | A/Chief Executive Officer | Pilbara Development Commission | PO Box 544 | PORT HEDLAND | WA | 6721 |
| cd | Christine | Rowland | Pilbara Sub-Regional NRM Strategist | Rangeands NRM Coordinating Group Pilbara Development Commission | PO Box 294 | KARRATHA | WA | 6714 |
| cd | Norm | Caporn | Coordinator Mining, Petroleum, Environmental Impact Assessment | Department of Conservation & Land Management (CALM) | Locked Bag 104 | BENTLEY DELIVERY CENTRE | WA | 6983 |

| Copy | First Name | Surname | Position | Company | Address | Town | State | Post Code |
|---|---|---|---|---|---|---|---|---|
| h | Daniel | Coffey | Environmental Officer | Department of Conservation & Land Management (CALM) | Locked Bag 104 | BENTLEY DELIVERY CENTRE | WA | 6983 |
| h | Julia | Lawson | Project Officer | Department of Environment Audit Branch | PO Box K822 | PERTH | WA | 6842 |
| h | Lisa | Chandler | Audit Manager | Department of Environment Audit Branch | PO Box K822 | PERTH | WA | 6842 |
| h | Seth | Johnson | Senior Hydrogeologist | Department of Environment Water & Rivers Commission | PO Box 6740 | EAST PERTH | WA | 6892 |
| h | John | MacPherson | Principal Environmental Officer (Noise) | Department of Environment Noise Branch | PO Box K822 | PERTH | WA | 6842 |
| cd | Rick | Bretnall | Senior Engineer | Department of Environment Water & Rivers Commission | PO Box 6740 | EAST PERTH | WA | 6892 |
| cd | Mark | Pearcy | Senior Engineer / Hydrologist | Department of Environment Water & Rivers Commission | PO Box 6740 | EAST PERTH | WA | 6892 |
| cd | John | Dell | Environmental Officer | Department of Environment | PO Box K822 | PERTH | WA | 6842 |
| h x 2 | Julie | O'Donohughe | Project Manager - Resource Projects | Department of Industry and Resources | PO Box 7606 | CLOISTERS SQUARE | WA | 6850 |
| h | Charles | Newland | | Department of Industry and Resources | PO Box 7606 | CLOISTERS SQUARE | WA | 6850 |
| **NGO'S** | | | | | | | | |
| h | Cameron | Poustie | Biodiversity Officer | Conservation Council of WA (Inc.) | 2 Delhi Street | WEST PERTH | WA | 6005 |
| h | Jo-Anne | Tregonning | Conservation Officer | Wildflower Society of WA (Inc.) | PO Box 64 | NEDLANDS | WA | 6909 |
| h | Rob | Davis | Chairman | Birds Australia Western Australia (Inc.) | 8 Ridgeway Place | MAHOGANY CREEK | WA | 6072 |
| h | Paul | Gamblin | Senior Policy Officer | World Wildlife Fund | PO Box 4010 | WEMBLEY | WA | 6026 |
| H | Edwina | Davies-Ward | | City West Lotteries House 2 Delhi Street | WEST PERTH | WA | 6005 | |

| Copy | First Name | Surname | Position | Company | Address | Town | State | Post Code |
|---|---|---|---|---|---|---|---|---|
| **LOCAL GOVERNMENT** | | | | | | | | |
| h x 3 | Allen | Cooper | Chief Executive Officer | Shire of East Pilbara | PMB 22 | NEWMAN | WA | 6753 |
| h | Lynne | Craigie | Shire President | Shire of East Pilbara | Lot 15578 Woodstock Street | NEWMAN | WA | 6753 |
| cd | | | Deputy Shire President | Shire of East Pilbara | PO Box 429 | NEWMAN | WA | 6753 |
| cd | Melvin Jason | Farmer | | Shire of East Pilbara | Via Jigalong Aboriginal Community PMB 7 | NEWMAN | WA | 6753 |
| cd | Jim | Akesson | Councillor | Shire of East Pilbara | Lot 1568 Woodstock Street | NEWMAN | WA | 6753 |
| cd | Lynne | Craigie | Councillor | Shire of East Pilbara | 8 Selman Avenue | NEWMAN | WA | 6753 |
| cd | Bill | Despotovski | Councillor | Shire of East Pilbara | 53 Bondini Drive | NEWMAN | WA | 6753 |
| cd | Anita | Grace | Councillor | Shire of East Pilbara | PO Box 644 | NEWMAN | WA | 6753 |
| cd | Doug | Stead | Councillor | Shire of East Pilbara | 17 Yanboohman Close | NEWMAN | WA | 6753 |
| cd | John | Young | Councillor | Shire of East Pilbara | Lot 234 Skull Springs Road | NULLAGINE | WA | 6758 |
| cd | Lang | Coppin | Councillor | Shire of East Pilbara | Yarrie Station PO Box 805 | PORT HEDLAND | WA | 6721 |
| cd | John | Leeds | Councillor | Shire of East Pilbara | Pardoo Station RMB | PORT HEDLAND | WA | 6721 |
| cd | John "Tinny" | Currell | Councillor | Shire of East Pilbara | PO Box 29 | MARBLE BAR | WA | 6760 |
| cd | Karen | Knuckey | Councillor | Shire of East Pilbara | 7 Rudall Ave | NEWMAN | WA | 6753 |
| h x 3 | Roy | Winslow | Town Planner | Town of Port Hedland | | | | |
| h | Chris | Adams | Chief Executive Officer | Town of Port Hedland | PO Box 41 | PORT HEDLAND | WA | 6721 |

| Copy | First Name | Surname | Position | Company | Address | Town | State | Post Code |
|---|---|---|---|---|---|---|---|---|
| h | Stan | Martin | Mayor | Town of Port Hedland | PO Box 41 | PORT HEDLAND | WA | 6721 |
| cd | Arnold | Carter | Deputy Mayor | Town of Port Hedland | PO Box 41 | PORT HEDLAND | WA | 6721 |
| cd | Shane | Sear | Councillor | Town of Port Hedland | PO Box 41 | PORT HEDLAND | WA | 6721 |
| cd | Arthur | Gear | Councillor | Town of Port Hedland | PO Box 41 | PORT HEDLAND | WA | 6721 |
| cd | Des | Pike | Councillor | Town of Port Hedland | PO Box 41 | PORT HEDLAND | WA | 6721 |
| cd | Jan | Gillingham | Councillor | Town of Port Hedland | PO Box 41 | PORT HEDLAND | WA | 6721 |
| cd | Trona | Young | Councillor | Town of Port Hedland | PO Box 41 | PORT HEDLAND | WA | 6721 |
| cd | George | Dacacche | Councillor | Town of Port Hedland | PO Box 41 | PORT HEDLAND | WA | 6721 |
| cd | Grant | Bussell | Councillor | Town of Port Hedland | PO Box 41 | PORT HEDLAND | WA | 6721 |
| h | Steven | Deckert | Chief Executive Officer | Shire of Ashburton | PO Box 567 | TOM PRICE | WA | 6751 |
| h | Leanne | Corker | President | Shire of Ashburton | Red Hill Station | PANNAWONICA | WA | 6716 |
| cd | Anne Marie | Leaddie | Deputy President | Shire of Ashburton | 739 Mungarra Street | TOM PRICE | WA | 6751 |
| cd | Bill | McAullay | Councillor | Shire of Ashburton | PO Box 70 | ONSLOW | WA | 6710 |
| cd | Lorraine | Thomas | Councillor | Shire of Ashburton | 66 Fifth Avenue | WITTENOOM | WA | 6752 |
| cd | Tony | Bloem | Councillor | Shire of Ashburton | 768 Larnook Street | TOM PRICE | WA | 6751 |
| cd | Barry | Chant | Councillor | Shire of Ashburton | 1037 Gunggari Circuit | TOM PRICE | WA | 6751 |
| cd | Robert | Lee | Councillor | Shire of Ashburton | 30 Harding Street | PANNAWONICA | WA | 6716 |

| Copy | First Name | Surname | Position | Company | Address | Town | State | Post Code |
|---|---|---|---|---|---|---|---|---|
| cd | Linton | Rumble | Councillor | Shire of Ashburton | 712 Jope Crt | PARABURDOO | WA | 6754 |
| cd | Elaine | Walsham | Councillor | Shire of Ashburton | Pannawonica Ward | PANNAWONICA | WA | 6716 |
| cd | Peter | Foote | Councillor | Shire of Ashburton | 511 Ashburton Ave | PARABURDOO | WA | 6754 |
| **MP's** | | | | | | | | |
| cd | Matt | Birney | MLA | Mining & Pastoral | 305 Hannon Street | KALGOORLIE | WA | 6430 |
| cd | John | Bowler | MLA | Mining & Pastoral | 66 Burt Street | BOULDER | WA | 6432 |
| cd | Carol | Martin | MLA | Mining & Pastoral | PO Box 1433 | BROOME | WA | 6725 |
| cd | Fred | Riebeling | MLA | Mining & Pastoral | PO Box 1050 | KARRATHA | WA | 6714 |
| cd | Rod | Sweetman | MLA | Mining & Pastoral | PO Box 769 | CARNARVON | WA | 6701 |
| cd | Larry | Graham | MLA | Mining & Pastoral | Parliament House | PERTH | WA | 6000 |
| h | Robin | Chapple | MLC | Mining & Pastoral | PO Box 1598 | WEST PERTH | WA | 6872 |
| cd | John | Fischer | MLC | Mining & Pastoral | Level 3, 9 Colin Street | WEST PERTH | WA | 6872 |
| cd | Norman | Moore | MLC | Mining & Pastoral | Level 1, 8 Parliament Place | PERTH | WA | 6000 |
| cd | Jonathan | Ford | MLC | Mining & Pastoral | PO Box 105 | NEWMAN | WA | 6753 |
| cd | Thomas | Stephens | MLC | Mining & Pastoral | PO Box 344 | BROOME | WA | 6725 |
| **BUSINESSES** | | | | | | | | |
| h | Shari | Kyle | Secretary | Newman Chamber of Commerce | PO Box 611 | NEWMAN | WA | 6753 |

| Copy | First Name | Surname | Position | Company | Address | Town | State | Post Code |
|---|---|---|---|---|---|---|---|---|
| h | Natasha | Whitcher | Managing Secretary | Port Hedland Chamber of Commerce | PO Box 85 | PORT HEDLAND | WA | 6721 |
| cd | Chris | Jones | | Chris Jones Plumbing (CJP) | PO Box 2058 | SOUTH HEDLAND | WA | 6722 |
| cd | Julie | Moyce | Acting Manager | Employment Directions Network Pilbara | PO Box 521 | NEWMAN | WA | 6753 |
| h | Tricia | Young | Manager | South Hedland Shopping Centre | PO Box 2174 | SOUTH HEDLAND | WA | 6722 |
| h | Laurel | Tate | Manager Information | Maunsell Australia Pty Ltd | PO Box 81 | LEEDERVILLE | WA | 6902 |
| cd | Wayne | Ness | | NHP Electrical Engineering Products | PO Box 799 | PORT HEDLAND | WA | 6721 |
| **PASTORAL STATIONS** | | | | | | | | |
| h | Donald | Hoar | | Balfour Downs Station | PMB 26 | NEWMAN | WA | 6753 |
| h | The | Manager | | Bonney Downs Station | PO Box 21 | NULLAGINE | WA | 6758 |
| h | The | Manager | | Boodarie Station | PO Box 2077 | SOUTH HEDLAND | WA | 6722 |
| h | Greg & Cynthia | Stoney | | Hillside Station | PO Box 111 | MARBLE BAR | WA | 6760 |
| h | Colin & Bettye | Brierly | | Indee Station | PO Box 67 | PORT HEDLAND | WA | 6721 |
| h | Barry & Bella | Gratte | | Marillana Station | PO Box 62 | NEWMAN | WA | 6753 |
| h | Ken | Rick | | Mulga Downs Station | PMB 6 | TOM PRICE | WA | 6751 |
| h | Geoffrey & Anne | Paull | | Noreena Downs Station | PO Box 568 | NEWMAN | WA | 6753 |
| h | Murray & Ramon | Kennedy | | Roy Hill Station | PO Box 83 | NEWMAN | WA | 6753 |
| h | Kev | Dean | Station Manager | Wallareenya Station | PO Box 781 | PORT HEDLAND | WA | 6721 |

| Copy | First Name | Surname | Position | Company | Address | Town | State | Post Code |
|---|---|---|---|---|---|---|---|---|
| h | Peter | Cook | Lesseee | Wallareenya Station | Gallatica Pty Ltd<br>18 Chipping Road | CITY BEACH | WA | 6015 |
| **COMMUNITY GROUPS** | | | | | | | | |
| 2 h & 2 cd | Kelly | Howlett | Sustainability Development Officer | Care for Hedland Environmental Group | Town of Port Hedland<br>PO Box 41 | PORT HEDLAND | WA | 6721 |
| h | Arnold | Carter | President | Port Hedland Rate Payers Association | PO Box 217 | PORT HEDLAND | WA | 6721 |
| 1 h & 6 cd | Shane | Sear | President | Wedgefield Association Inc. | PO Box 722 | PORT HEDLAND | WA | 6721 |
| h | Ken | Walker | President | East Pilbara LCDC | PO Box 241 | NEWMAN | WA | 6753 |
| h | Robyn | Richardson | President | Roebourne / Port Hedland LCDC | Mt Florence<br>PMB 4 | TOM PRICE | WA | 6751 |
| h | Leanne | Robertson | Employment and Training Manager | Aboriginal Chamber of Commerce | PO Box 270 | PORT HEDLAND | WA | 6721 |
| **PUBLIC** | | | | | | | | |
| | | | | | | | | |
| **CONTRACTORS** | | | | | | | | |
| 2 x h | Worley | | | | | | | |
| h | Andy | Ball | | | Suite 4,125 Melville Parade | COMO | WA | 6152 |
| h | Mike | Bamford | | Bamford Consulting Ecologists | 23 Plover Way | KINGSLEY | WA | 6026 |
| h | Daniel | Lloyd | Accoustic Engineer | Lloyd Accoustics | Level 3, The Hyatt Centre<br>20 Terrace Road | EAST PERTH | WA | 6004 |
| h | Daniel | Marsh | | ERM | PO Box 7338 | CLOISTERS SQUARE | WA | 6850 |
| h | Chris | Muller | | Chris Muller Consulting Services | 103 Edgewater Drive | EDGEWATER | WA | 6027 |

| Copy | First Name | Surname | Position | Company | Address | Town | State | Post Code |
|---|---|---|---|---|---|---|---|---|
| h | Libby | Mattiske | | Mattiske Consulting | PO Box 437 | KALAMUNDA | WA | 6076 |
| h | Brian | Bell | | Environ | Suite 3, Level 2<br>200 Adelaide Terrace | EAST PERTH | WA | 6004 |
| h | Kirsty | Pope | Environmental Scientist | Environ | Suite 3, Level 2<br>200 Adelaide Terrace | EAST PERTH | WA | 6004 |
| 10 hard copies | FMG | | | | | | | |
| 20 hard copies | Doug Betts | | | | | | | |
| 10 CD copies | Doug Betts | | | | | | | |
| 5 hard copies | Cedric | Davies | Environmental Compliance Officer | Yamatji Marlpa Land & Sea Council | PO Box Y3072<br>East St Georges Terrace | PERTH | WA | 6832 |

## Appendix 3

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Fortescue Metals Group Ltd
ACN: 002 594 872
Fortescue House
50 Kings Park Road West Perth
Western Australia 6005
PO Box 910, West Perth, Western Australia 6872

Telephone: + 61 8 **9266 0111**
Facsimile: + 61 8 9266 0188
Website: **www.fmgl.com.au**

11 July 2005

(Recipient's Name)
(Recipient's Address) Via Facsimile: (Fax number)

Dear (Recipient),

**Cloud Break Mining Proposal**

As you are aware Fortescue Metals Group Ltd (FMG) is proposing to develop the Pilbara Iron Ore & Infrastructure Project, which involves a series of iron ore mines approximately 60km north of the town of Newman, port facilities in Port Hedland and a connecting railway system.

The company has submitted two Public Environmental Review (PER) reports (Stage A – Proposed north-south rail infrastructure and Stage B – Development of four mining operations and connecting east-west railway) to the Environmental Protection Authority (EPA) for assessment, which the public was given the opportunity to comment on.

Stage A of the project is currently being assessed by the Minster for the Environment and Science and it is anticipated that a decision regarding environmental approval of the project will be made by the end of August 2005.

Stage B of the project is currently being reviewed by the EPA and response to submissions are being prepared by FMG. It is anticipated that a decision regarding the approval of the Stage B PER will be in October 2005.

FMG is currently preparing another PER for the new proposed "Cloud Break" mining operation, which is located in the Chichester Ranges, beside the Christmas Creek mine area. I have enclosed a map showing the location of the proposed Cloud Break Mine.

Enclosed for your information is the Cloud Break Scoping Document which briefly outlines the project. Should you wish to meet with representatives from FMG to discuss the proposed plans and any issues or concerns that you may have, please do not hesitate to contact Diane Dowdell on (08) 9266 0111 to arrange a mutually suitable time to discuss the project.

Yours sincerely
**Fortescue Metals Group Ltd**

**Eamon Hannon**
General Manager, Exploration

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## Appendix 4

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Fortescue Metals Group Ltd
ACN: 002 594 872
Fortescue House
50 Kings Park Road West Perth
Western Australia 6005
PO Box 910, West Perth, Western Australia 6872

Telephone: + 61 8 **9266 0111**
Facsimile: + 61 8 9266 0188
Website: **www.fmgl.com.au**

12 September 2005

«First_Name» «Surname»
«Position»
«Company»
«Address»
«Town» «State» «Post_Code»

Dear «First_Name»

As you are aware Fortescue Metals Group Ltd (FMG) is developing the Pilbara Iron Ore & Infrastructure Project. This project involves a series of iron ore mines approximately 60km north of the town of Newman, port facilities in Port Hedland and a connecting railway system.

FMG has already released for public comment two proposals:

**Stage A –** Port and north-south rail infrastructure; and
**Stage B** –Mining operations and a connecting east-west railway.

Both stages were assessed by the Environmental Protection Authority (EPA) and the level of assessment set as a Public Environmental Review (PER). Due to FMG's ongoing commitment to exploration in the Pilbara region, we have identified an additional iron ore resource that we wish to mine in the region. This proposal was referred to the EPA and the level of assessment was also set as a PER.

We are now please to announce the release of the PER for the Cloud Break Iron Ore Mine – No Beneficiation.

This document will be available for public comment between the 12 September 2005 and 24 October 2005. Consultation has been ongoing throughout the development of the PER document and has included discussions with various Community Groups, Government Departments, Native Title Claimant groups, Pastoralists, Commonwealth Decision Making Authorities and members of the local communities.

I have enclosed for your information a copy of FMG's PER for the Cloud Break Iron Ore Mine – No Beneficiation proposal.

Representatives from FMG would like to extend an invitation to meet with you to discuss the proposed plan and any issues or concerns that you may have. Please contact me if you would like to organise a meeting. If you have any queries please do not hesitate to contact me on (08) 9266 0147 or 0407 190 571.

Yours sincerely

**Diane Dowdell**
Manager, Environment

Enc.

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