FORTESCUE METALS GROUP LIMITED

PILBARA IRON ORE & INFRASTRUCTURE PROJECT

Flood Study Overview

Anderson Point to White Hills

October 2004

EXECUTIVE SUMMARY

As part of FMG's Definitive Feasibility Study for the Pilbara Iron Ore and Infrastructure Project (the Project) a number of flood studies have been undertaken. This overview report has been provided to assist in the interpretation for the potential flood impacts of the Project on existing communities at Wedgefield and South Hedland.

The flood study was broken up into two units, north and south of the artificial barrier caused by the BHP Billiton Iron Ore (BHBPIO) railway line to the south of Anderson Point. Worley has undertaken the work and their reports are included in the appendices.

The difference between maximum water depths for existing and Project bathymetry is shown in Figure E1 below. It is evident from the plot that the development has an insignificant effect on the flood water levels for the 1:50 year storm surge event throughout the model domain. Storm surge/flood levels at Wedgefield will not be affected by the Project north of the BHPBIO Finucane Island rail line.

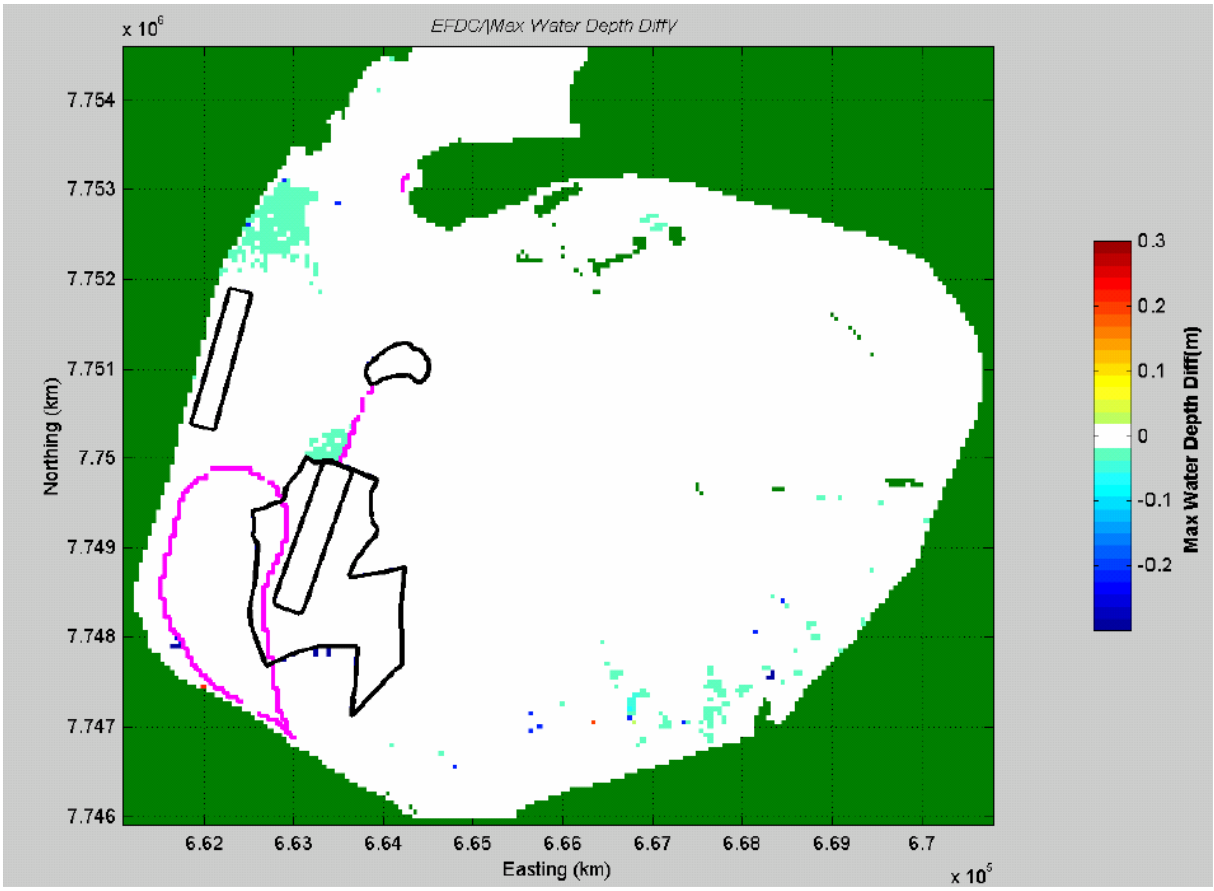

Figure E1: 1:50 Year Difference in Maximum Depth Between Existing and Project Layouts. White Areas Represent Areas of Insignificant Difference.

The Project's rail embankment in the area south of the North West Coastal Highway will reduce the peak flood level at the South West Creek bridge and hence potential overflow into

South Creek and its consequential impacts on South Hedland and Wedgefield. The flood peak reduction occurs as the catchment area is initially divided by the Project's railway embankment and the flows are rejoined via culverts south of the bridge. These culverts act as flow restrictors thus delaying some of floodwaters and hence reduce the flood peak at this bridge.

The effect of Project's rail embankment in the area between North West Coastal Highway and the BHPBIO Finucane Island rail line will assist in reducing flooding in Wedgefield by assisting in diverting current potential flood water from flowing into South Creek. This is until the Project's rail embankment is over topped.

In conclusion the Project's impact can be seen as causing no negative impacts on the flood levels at Wedgefield and South Hedland.

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1 INTRODUCTION

As part of FMG's Definitive Feasibility Study for the Pilbara Iron Ore and Infrastructure Project (the Project) a number of flood studies have been undertaken to determine:

- the potential impacts of the Project on existing communities at Wedgefield and South Hedland, and:
- anticipated flood levels to allow engineering design to progress.

The flood study was broken up into two units, north and south of the artificial barrier caused by the BHBPIO railway line to the south of Anderson Point. Worley has undertaken the work and their reports are included in the appendices.

This overview is provided to assist in the interpretation for the potential impacts of the Project on existing communities at Wedgefield and South Hedland

2 PROJECT DEVELOPMENT AT PORT HEDLAND

The Project development in the Port Hedland area consists of the following:

- The railway approaches the Port Hedland area from the south and will be to the west of the White Hill rural estate and follow the rise to cross the North West Coastal Highway (NWCH) within 500 m west of the road bridge over South West Creek.
- From there the railway will turn into a marshalling yard between NWCH and the BHPBIO rail line to Finucane Island.
- The railway will cross the BHPBIO Finucane Island between South Creek and South West Creek in a westerly direction and form a loop behind Anderson Point.
- A two wagon tippler will be located on this rail loop which will feed, by conveyor, a screening plant to the east of the rail loop.
- The screening plant will be located at the southern end of a 2.5 Mt, 1.5 km long stockpile both of which are constructed on reclaimed tidal flats.
- A shiploader conveyor will run from the northern end of the stockpile to a loading berth off Anderson Point for up to 250,000 DWT vessels with an adjacent vessel parking bay.

3 BACKGROUND

The area of the flood study is characterised by its flatness and hence the concern about potential impacts on local communities. Two creek systems, South Creek and South West Creek, collect the water from an area to the south of South Hedland and flow to the sea via channels to the west of South Hedland. Refer Figure 3.1.

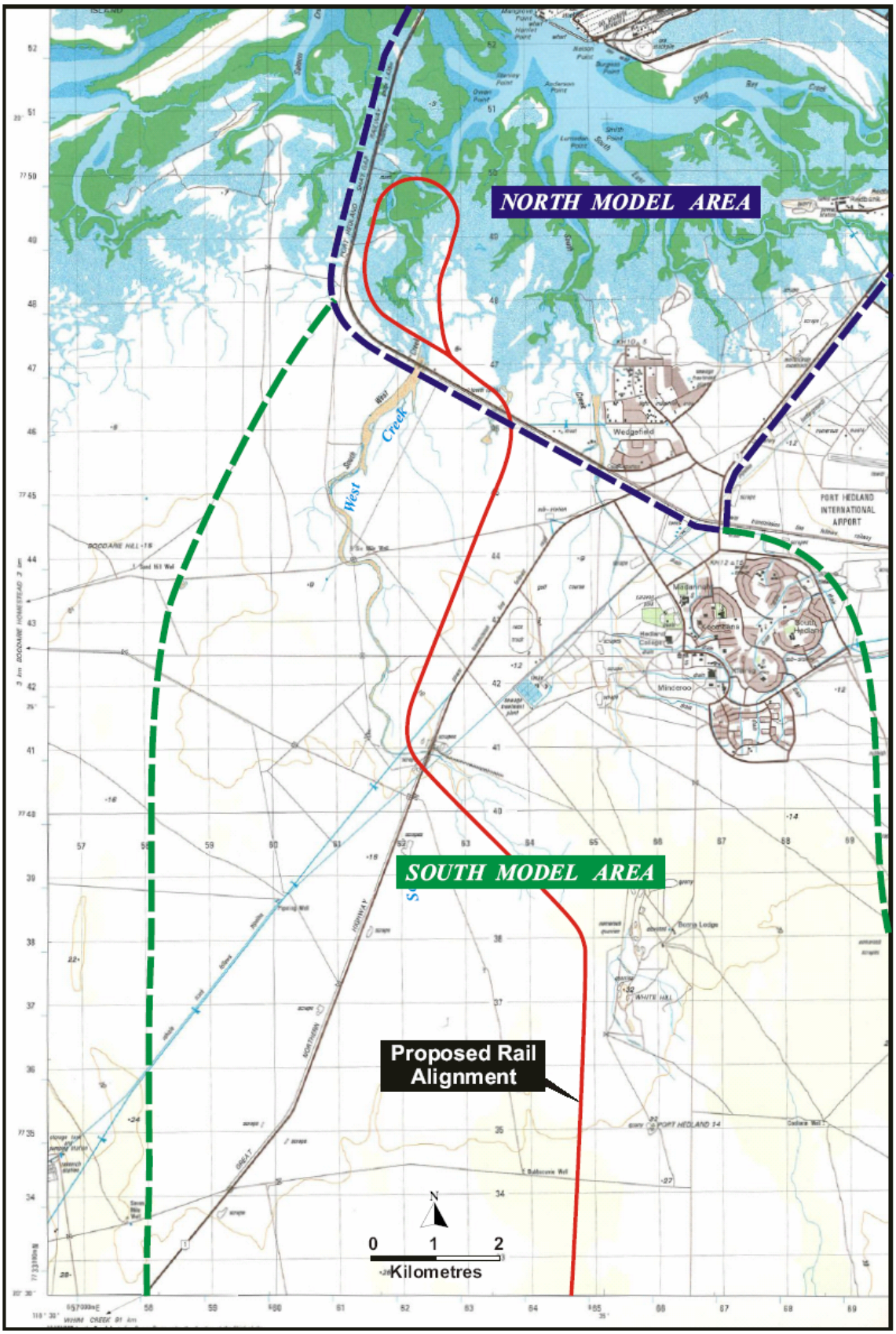

Figure 3.1 Flood Study Area and Major Features

When considering the impact of floods it is important to note that the speed of the floodwater is determined by the slope of the land and the roughness of the surface (friction). Refer Figure 3.2

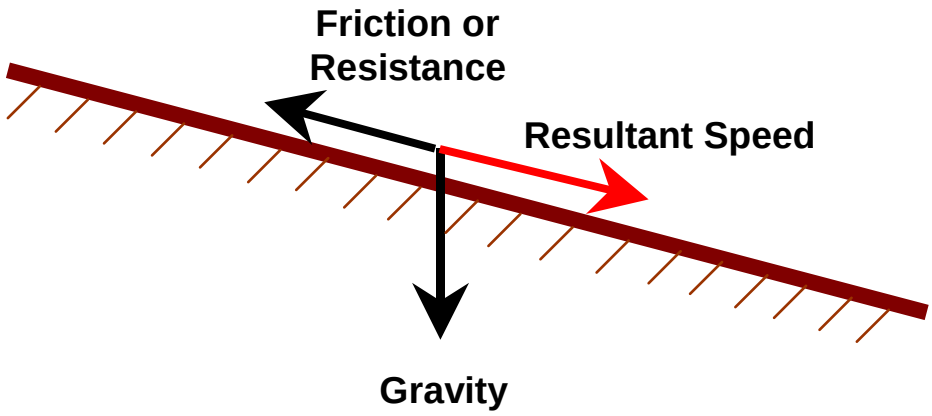

Figure 3.2 Floodwater Speed of Advance

Therefore as the speed over flat land is slow it causes a delay effect between a rainfall event upstream and flooding downstream. For the catchment area of South Creek and South West Creek this delaying effect is estimated to be of the order of 18 hours.

Barriers, such as natural rises, hills, roads, etc will affect the speed of advance of floodwaters. They can channel flow in a particular direction and also collect or form pools behind the barrier. This pooling has two aspects, damming and a backwater effect, as shown in Figure 3.3.

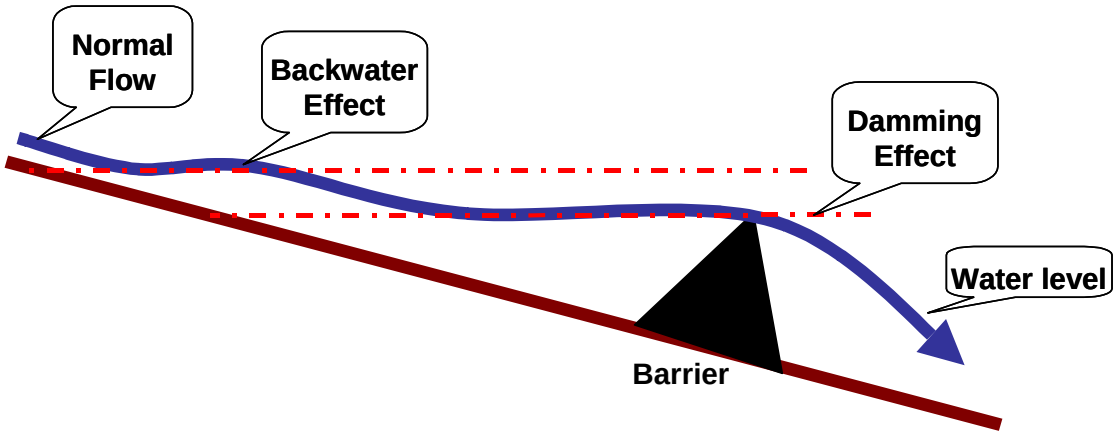

Figure 3.3 Backwater Effects of Barriers

The damming effect is the obvious effect but in flood studies the more important aspect is the backwater effect. This is where normal flow encounters stilling effect of the dam and its forward momentum must be dissipated. This occurs by raising the water level above that of the damming effect. This can be mathematically modelled

as the effect is dependent on the size of the barrier and the slope of the land on the upstream side of the barrier. For example the backwater effects for the Main Roads bridge over South West Creek has been estimated to be up to 400 m.

It is important to note that the speed of advance of floodwaters upstream of a backwater zone are unaffected by the backwater effect.

4 NORTHERN AREA (ANDERSON PT) STUDY

The focus of the flood study was to determine if the construction of the rail loop and the reclamation of tidal flats, i.e. loss of cross-section area in the flood zone, would impact on flooding in Wedgefield. The impact had to consider both storm surge and flooding.

Worley simulated storm surge and flooding impact using "EFDC" modelling software, which is presently supported by the USA EPA. Input data includes existing and future harbour bathymetry, contour information provided by the Port Hedland Port Authority and previous studies for storm surge and flood flows predictions (GEMS, 2000).

Their report, the "Oceanic Storm Surge Study Report", refer Appendix 1, indicates that the increase in flood level at Wedgefield due to the Project would be insignificant, i.e. no measurable difference in height. The results are shown diagrammatically in Figure 4.1.

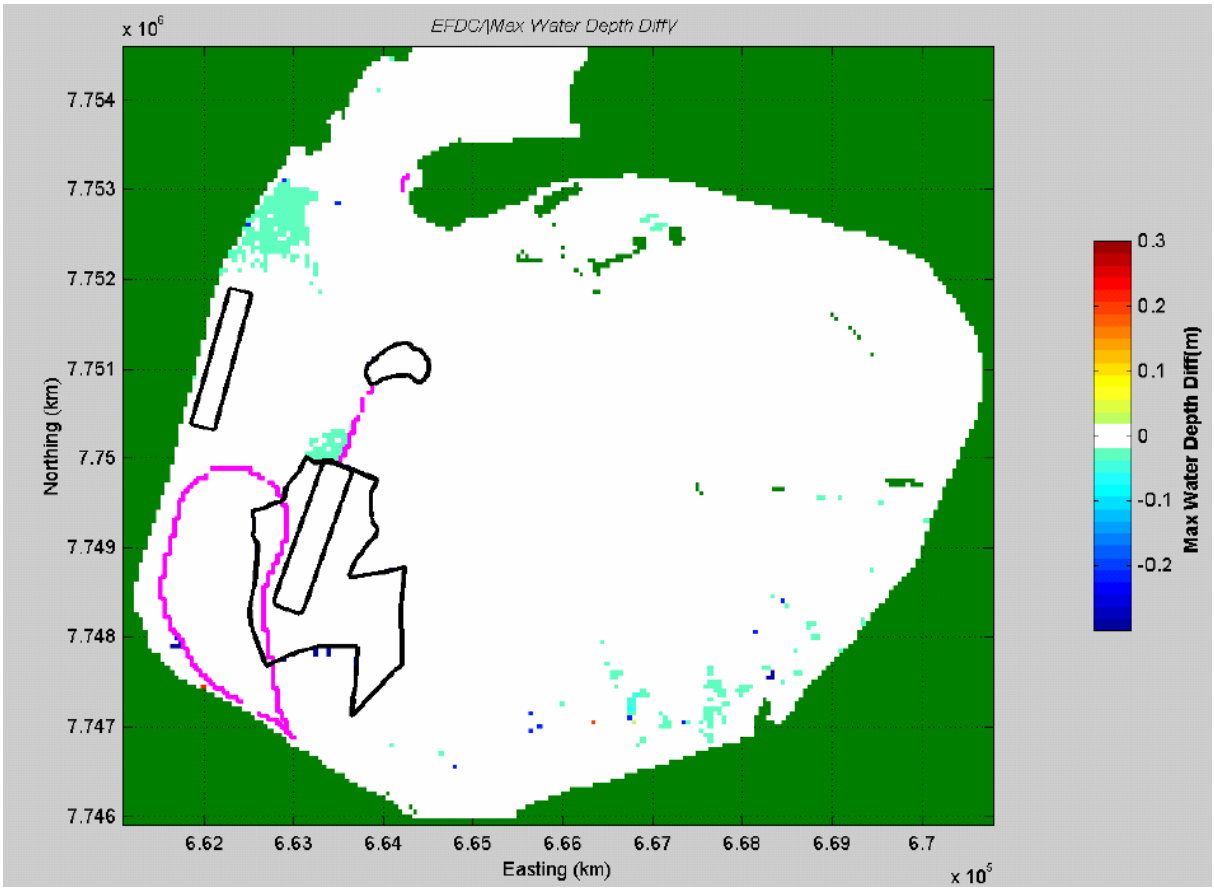

Figure 4.1 1:50 Year Difference in Maximum Depth Between Existing and Project Layouts. White Areas Represent Areas of Insignificant Difference.

The Worley report also has similar figures for the 100 year event.

5 SOUTHERN AREA (CATCHMENT)

As a result of earlier hydrological studies by Aquaterra (2004) as part of the Stage A PER, FMG had to relocate its railway line further west than the Hope Downs rail alignment i.e. to the ridge on the western side of South West Creek south of the NWCH. This relocation was done to avoid increasing potential for flood issues in South Hedland. Therefore the focus of the Worley work was to determine if this alignment and the construction of marshalling yards would affect the flows in South Creek and South West Creek and hence flood levels in South Hedland and Wedgefield.

This Worley study used "CulvertW" and HEC-RAS" software programs for modelling flood heights. Input data includes, contour information provided by FMG, previous Main Roads and previous studies for flood flows predictions (GEMS 2000). It should be noted that under certain flood conditions the South West Creek overflows into South Creek adjacent to the South Hedland Rural Estate.

The Project's rail embankment in the area south of the NWCH divides the catchment area for South West Creek such that approximately 25% is to the west of the embankment. This flow rejoins South West Creek flow just south of the NWCH bridge via a series of culverts. These culverts act as flow restrictors thus delaying the floodwaters and hence reducing the peak flood level at the bridge. The reduced peak flood level therefore reduces the potential of South West Creek overflowing into South Creek and its consequential impacts on South Hedland and Wedgefield.

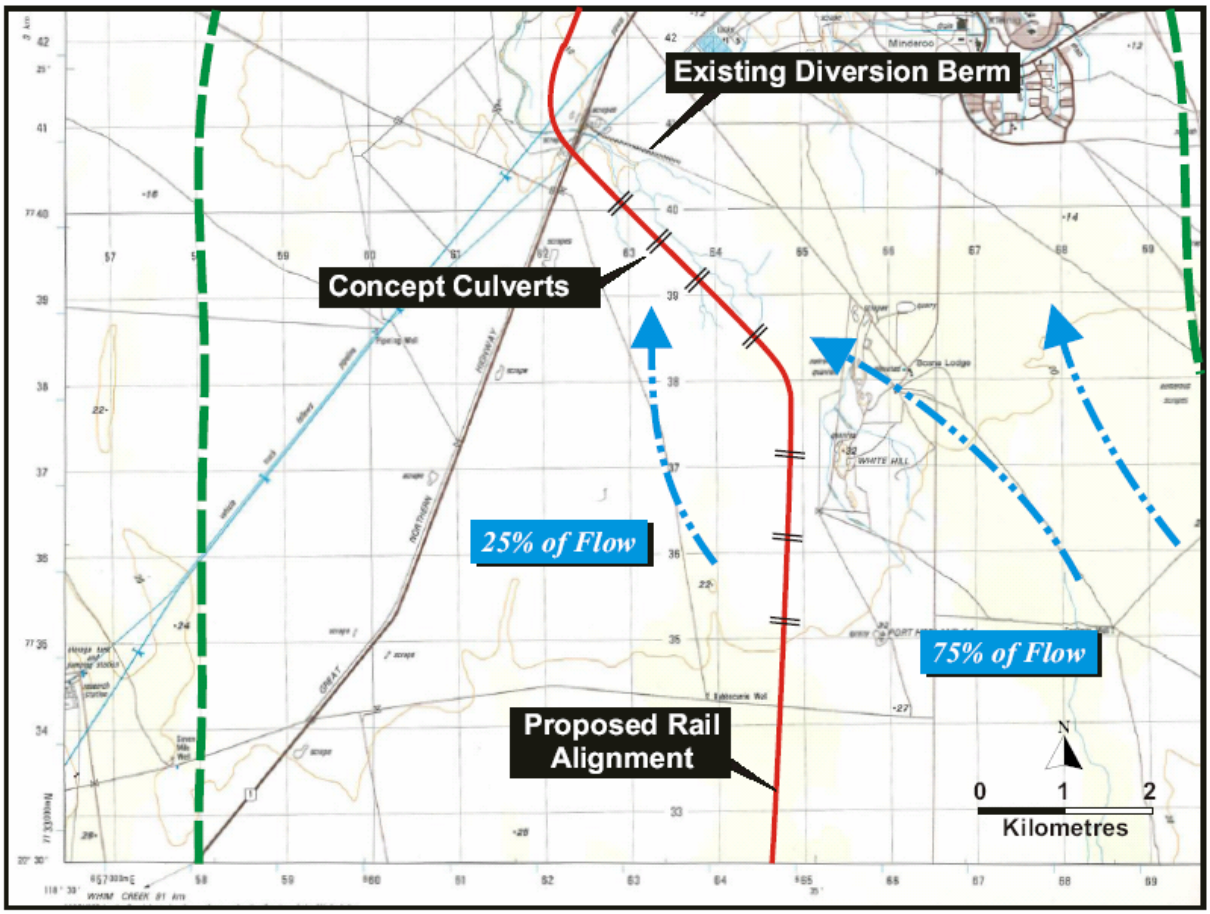

Figure 5.1 Catchment Area Flow Splitting

In the relatively flat featureless area between the NWCH and the BHPBIO Finucane Island railway line through which both South and South West Creeks flow is a difficult area to model as there will be cross flows from one creek to the other with only a small differences in ground level. The Project's railway line and marshalling yard embankments form a barrier between South Creek and South West Creek thus diverting floodwater that may have previously flowed into South Creek from South West Creek. This will assist in reducing potential flooding in Wedgefield.

Note the above discussions only apply prior to the railway embankment being over topped.

6 HOPE DOWNS RAILWAY IMPACT

FMG does not have access to the proposed Hope Downs railway alignment but understands their approximate alignment (based on discussions with various government departments and their PER).

At present their alignment, FMG understands, has not moved to the ridge west of South West Creek as per the FMG Project's alignment. When this occurs FMG believe their impact will be the same as the Project's as:

- The alignments are parallel south of the NWCH.
- The alignment between NWCH and the BHPBIO railway line is between the Project's alignment and South West Creek and therefore will form a double barrier to the potential movement of water from South West Creek to South Creek.
- This double barrier will reduce potential for increasing flooding issues in South Hedland and Wedgefield.

In the storm surge area the impact of Hopes Downs alignment does not affect the flows as the alignment is between BHPBIO and the Project's.

Therefore FMG believe the cumulative impact, based on Hope Downs having a similar alignment to the Project's will be the same as the FMG Project's impact.

7 CONCLUSIONS AND RECOMMENDATIONS

The additional Storm Surge and Flood Hydrology studies conducted by Worley (attached as appendices) have shown that the proposed FMG port and rail layout will not increase flooding at surrounding residential areas including Wedgefield and South Hedland. In fact, FMG's re-alginment of the railway near the White Hills area should reduce the flood impact at the South West Creek bridge crossing and also reduce backwater effects. This is expected to reduce the existing flood levels experienced at South Hedland and Wedgefield.

The studies have also shown that there will not be an impact on flood levels at Wedgefield or South Hedland due to the combined effects of storm surge and overland flooding. This is a result of the significant lag between the peak oceanic storm surge and the peak overland flood flow, due to the time surface flows take to propagate through the catchment.

These studies have given adequate information for the current stage of FMG's project design and also provides sufficient information for environmental impact assessment purposes, to supplement earlier work undertaken by Aquaterra (2004). The studies have also resulted in a number of recommendations for consideration by FMG during detailed engineering design. These recommendations, including more detailed flood/storm surge modelling and flood protection engineering measures, are being considered by FMG as part of the detailed engineering studies currently underway.

8 REFERENCES

Aquaterra Consulting, 2004. Pilbara Iron Ore and Infrastructure Project - Stage A: Port and North-South Railway Surface Hydrology. Unpublished report prepared for Fortescue Metals Group Limited.

Global Environmental Modelling Systems (GEMS), 2000: Greater Port Hedland Storm-Surge Study: Final Report to WA Ministry for Town Planning and Port Hedland Council.

Appendix 1

WORLEY'S

OCEANIC STORM SURGE STUDY

Appendix 2

WORLEY'S

CATCHMENT FLOOD STUDY