# PETER H. STITT & ASSOCIATES PTY. LTD.

ABN 24 001 395 044

MINING & GEOLOGICAL CONSULTANTS

5th Floor, 32 York Street,
SYDNEY NSW 2000 AUSTRALIA

Phone 02 9299 1403 International 61 2 9299 1403
Fax 02 9262 2395 International 61 2 9262 2395
Email peterhstitt@aol.com


# TECHNICAL NOTE NO. 4/2011

# THE NORTH TUNCURRY DEVELOPMENT PROJECT

**A Report Prepared For**

**Landcom**


**Peter Stitt**
**February 2012**

# CONTENTS

## ABSTRACT

Landcom is sponsoring the North Tuncurry Development Project (the NTDP) under an agreement with the Crown Lands Division of NSW Department of Primary Industry (Lands), the body that controls the land. The NTDP involves the re-zoning and sub-division of a 615ha site north of Tuncurry on the mid north coast of New South Wales. It is the intention of Landcom and Lands to develop the site in stages for a mix of land uses, including residential, industrial, education, retail, sporting and tourism.

It is possible that the site hosts heavy mineral (HM) sand resources that could be economic. As part of the planning and re-zoning process and as required by the Great Lakes Council Forster/Tuncurry Conservation and Development Strategy, an assessment of the potential mineral resources is required as a pre-requisite to re-zoning. As such, Landcom has engaged Peter H Stitt & Associates Pty Ltd (PHSA) to carry out a study aimed at ascertaining whether there may in fact be a significant HM resource and to advise whether it may be worthwhile considering a mining operation within the boundaries of the NTDP Site.

**The conclusions and recommendations from this study are:**

i) On the basis of available data the NTDP Site, within its boundaries, could host a heavy mineral (HM) sand Inferred Resource of around 3,000,000t at a head grade of 0.7% HM (around 11kg/$m^3$) and a cut-off grade of 0.3% HM (around 5kg/$m^3$).

ii) With current buoyant commodity prices for rutile and zircon the in situ value of this resource is estimated to be in the range $14,000,000 to $23,000,000.

iii) On a stand-alone basis (in the absence of an established mining infrastructure) exploiting such a resource would be a costly exercise.

iv) The reality is that issues such as boundary setbacks and environmental constraints, particularly the impact of the Tuncurry Midge Orchid (listed as ‘critically endangered’ under both State and Federal legislation) on the Eastern Strandline will reduce the magnitude of this resource and its value, perhaps

significantly.

v) The NTDP Site's proximity to residential areas, schools and sporting facilities and environmental issues such the presence of the Tuncurry Midge Orchid are likely to promote objection to an HM mining project. It is PHSA's experience that objection can sometimes be launched for the specific purpose of marking a project uneconomic. This is particularly the case for mining projects.

vi) **Regardless of whether the resource estimates are high or low, it should be noted that on the national/international scene, this is an insignificant resource.**

vii) A Discounted Cash Flow/Net Present Value (DCF/NPV) Financial Model was constructed at conceptual scoping study level; assuming the resource in i). The model assumed:

- A 150t/hr dredge/ skid mounted concentrator producing a bulk HM concentrate.
- The bulk concentrate shipped to China for further processing into specification zircon, rutile and ilmenite.

viii) Revenue was computed for two cases, first on the basis of a set of likely commodity price estimates (CASE A) and a set of optimistic price estimates (CASE B).

ix) **In both cases, on the basis of the assumptions made and in round terms the model yielded a negative NPV, negative $7,500,000 for CASE A and negative $460,000 for CASE B. That is, the project would have lost $7,500,000 in CASE A and $460,000 in CASE B.**

x) The issues addressed in iv) and v) could push these NPV estimates even further into negative territory.

xi) **The conclusion reached from this study is that the NTDP Site does not host a resource capable of supporting a stand-alone HM sand mining project.**

# 1. INTRODUCTION

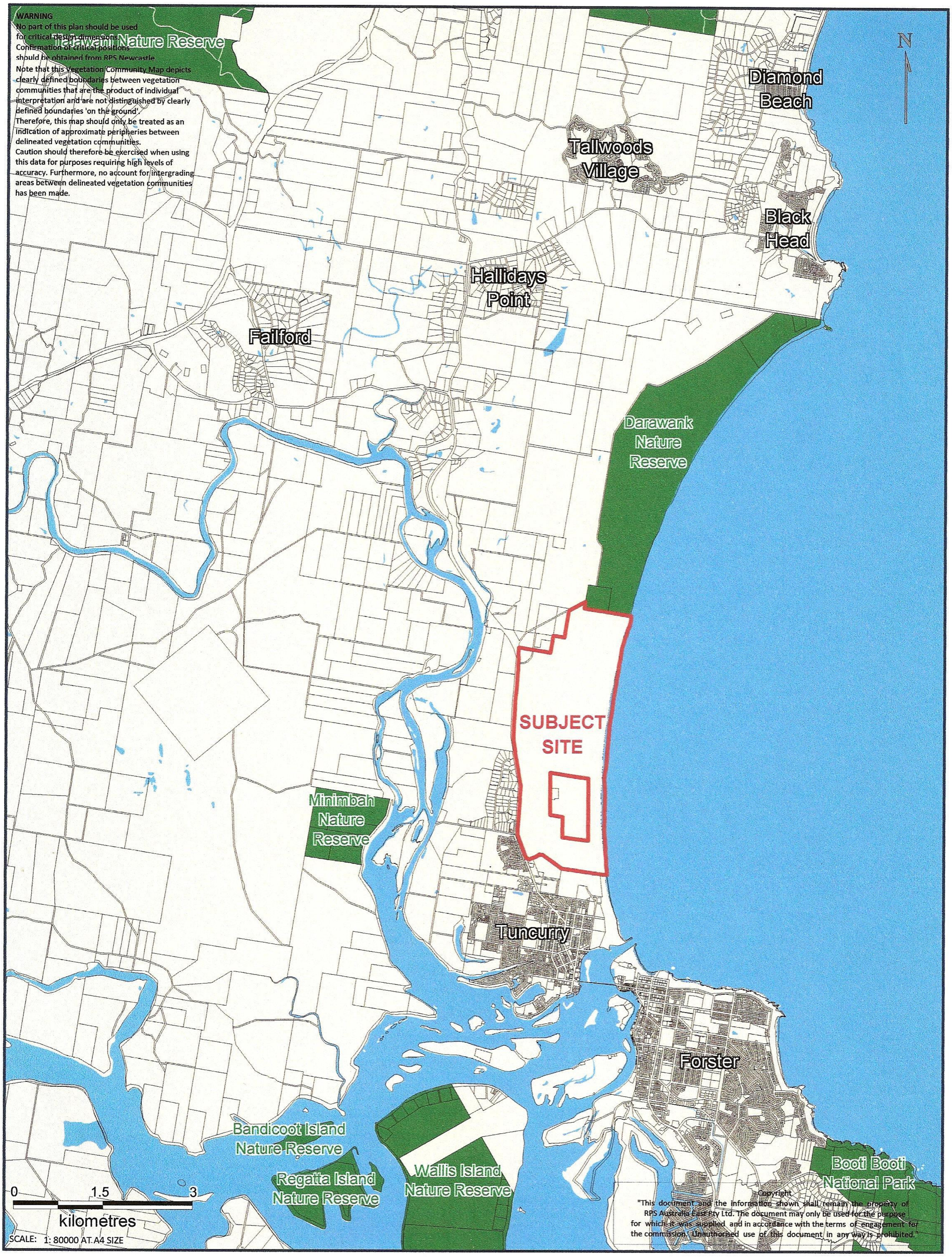
Landcom is sponsoring the North Tuncurry Development Project (the NTDP) under an agreement with the Crown Lands Division of NSW Department of Primary Industry (Lands), the body that controls the land.

The NTDP involves the re-zoning and sub-division of a 615ha site north of Tuncurry on the mid north coast of New South Wales (see Fig 1, reproduced by permission of RPS Australia East Pty Ltd) It is the intention of Landcom and Lands to develop the site in stages for a mix of land uses, including:

- approximately 2,200 – 3,000 dwellings (depending outcomes of technical investigations),
- employment lands,
- a new local neighbourhood centre incorporating retail, business and commercial floor space,
- tourist, community and education facilities; and
- open space and environmental conservation purposes.

It is possible that the site hosts heavy mineral (HM) sand resources that could be economic. As part of the planning and re-zoning process and as required by the Great Lakes Council Forster/Tuncurry Conservation and Development Strategy, an assessment of the potential mineral resources is required as a pre-requisite to re-zoning. As such, Landcom has engaged Peter H Stitt & Associates Pty Ltd (PHSA) to carry out a study aimed at ascertaining whether there may in fact be a significant HM resource and to advise whether it may be worthwhile considering a mining operation within the boundaries of the NTDP site.

This report follows from that commission (The Commission).




TITLE: FIGURE 1 : SITE LOCATION

LOCATION: NORTH TUNCURRY

DATUM: DATUM
PROJECTION: MGA ZONE 56 (GDA 94)

LAYOUT REF: J:\JOBS\26K\26414 - North Tuncurry\10-Drafting\Inventory Report Figures
VERSION (PLAN BY): P. HILLIER

CLIENT: LANDCOM
JOB REF: 26414

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au

RPS

## 2. APPROACH

In general and in terms of the Conditions of Engagement for The Commission PHSA is required to:

- Review and research project information and historical data relating to mineral sand mining and related exploration on the site.
- Consult with the NSW Department of Primary Industries on matters relating to this consultancy.
- Prepare an assessment of potential mineral resources on the site.
- Prepare a financial feasibility study and comment on the commercial viability of mining mineral sands from the NTDP site.
- Provide a concluding report

A two stage approach to The Commission was agreed between Savills and PHSA.

Stage 1 is to comprise a desk-top review of the geological/exploration data available for the NTDP site and its immediate surrounds plus the preparation of a report covering the issues set out above.

Stage 2, if justified by Stage 1, is to involve a limited programme of drilling, assaying and determination of mineralogy. Stage 2 would be triggered should Stage 1 indicate that a viable project, based on the NTDP site might be feasible.

This document comprises the Stage 1 report. No site visit was made in connection with this exercise.

# 3. BACKGROUND

## 3.1 The East Coast Resources

The coast of NSW from Newcastle to the Queensland border once hosted a vibrant mineral sands mining industry that in the 1960's to early 1970's was the world's major source of the minerals rutile ($TiO_2$) and zircon ($ZrSiO_4$).

The industry was based on heavy mineral (HM) accumulations, for the most part concentrated up on beaches by wave action in storm events. In round terms, heavy minerals have specific gravities (SG's) ranging from around 3 to around 5, versus that of the quartz sands (SG 2.65) that host the HM.

Heavy minerals can be sub-divided into valuable heavy minerals (VHM's, e.g. rutile, ilmenite and zircon) and trash (valueless) minerals such as garnet and tourmaline. VHM's have SG's generally in the range 4.2 to 5.2; whilst trash minerals have SG's generally in the range 3 to 4.3.

The heavy minerals themselves were derived from the weathering of rock masses inland and transported to the coast by major rivers such as the Hunter and the Richmond to be, as previously noted, concentrated up on beaches during storm events.

The HM accumulations associated with the present day beaches were the first to be noticed, and exploited. However it was subsequently realised that there were mineralised strandlines (ancient beaches) inland from the present coast line and these began to be mined.

These strandlines represent beaches established during the last three interglacial periods (say up to 400,000 years Before Present) of the current ice age, when sea levels were up to 8m higher than at present. In fact, strandlines up to 7km inland from the NTDP beach front have been mined in the past.

The last type of HM resource to be recognised and exploited were Aeolian (wind driven) accumulations derived from the re-working of wave concentrated material. They tend to be large and of low grade, although they can be easier to mine. The largest of these were the Myall High Dunes near Seal Rocks and the Stockton Bight Dunes north of Newcastle.

The Myall High Dunes were mined by Mineral Deposits Ltd (MDL, then a BHP subsidiary) until operations were shut down in the 1970's on environmental grounds. The Stockton High Dunes were mined into the early years of the 21st Century also by MDL, both as a BHP subsidiary and after the subsequent sale of the company.

Historically mined grades were generally in the range 1% to 10% HM but could be up to +70% for some small exceptional, resources and as low as 0.3%, again in exceptional circumstances. In the early days of the industry some of the exceptionally high grade deposits were worked by simply shovelling naturally concentrated HM off beaches into bags for export as bulk concentrates; e.g. Yamba Beach during World War 2. At the other extreme very low grade resources were sometimes successfully exploited by fully depreciated, high capacity plants, at long established locations; e.g. MDL's +1,700 tonnes/hour plant towards the end of the Viney Creek project.

A typical east coast HM suite is rutile 20 – 30%, zircon 20 to 30%, Ilmenite ($FeTiO_3$) 10 – 20%, monazite (Ce,Y,La $PO_4$ ) 1% and trash minerals the balance. Rutile and zircon tend to occur in close to equal percentages and commonly in the range 24 – 30%.

Rutile is an ore of titanium, however over 90% goes into the production of titanium dioxide opacifiers (also called pigments) for use in paints and plastics etc. Ilmenite is also a titanium dioxide pigment feed stock, however east coast ilmenites are high in chrome oxide ($Cr_2O_3$) that historically precluded their use in pigment production. This problem was partially solved about 20 years ago when technologies were developed that allowed east coast Ilmenite to be processed to yield a low chrome fraction, suitable for pigment production and a high chrome fraction.

Zircon was mainly used in the manufacture of high performance refractories, with lesser percentages going to foundry sands, high performance ceramics, plus zirconium metal and chemicals. However nowadays the bulk of the production goes to the manufacture of zircon opacifiers in glazes for ceramic tiles. This latter demand area is heavily influenced by China.

Monazite is a rare earth phosphate that contains thorium and as a result is mildly radioactive. Demand and price fluctuated greatly with radio activity a problem that has increased with time and community concerns.

Leucoxene is a weathering product of ilmenite, intermediate between ilmenite and rutile and of variable composition (the $TiO_2$ content increases with the degree of weathering) that is ignored for the purposes of this report.

Concentrate value depends on both grade and mineralogy, since there is a great disparity in the value of individual mineral species and prices and relative prices have varied greatly over the years. In the 1970/80's the major demand was for rutile. Since the minerals were present in roughly equal proportions, efforts to increase rutile production led to an equal increase in zircon production and a depressed price for zircon. The situation today is completely reversed with the dominant demand being for zircon. In addition prices have been rapidly increasing over recent years. This is illustrated by the indicative pricing data set out in Table 3.1 below.

**TABLE 3.1**

**Indicative HM Mineral Commodity Prices – 2009 to 2011**

| Mineral | Price August 2009 Us$/t | Price Early 2011 US$/t | Price May 2011 US$/t | Spot Price December 2011 US$/t |
|---|---|---|---|---|
| Premium Zircon | 800 | 1,100 – 1,300 | 1,700 – 2,500 | +3,000 |
| Premium Rutile | 400 | / | 800 – 1,000 | 2,000 |
| Sulphatable Ilmenite | 65 | / | 100 - 200 | 400 |

Note that spot prices are higher than long term contract prices and that changes in the A$/US$ exchange rate mean that in A$ terms, the 2009 to 2011 price increases are not quite as large as they first appear. In addition the 2009 price is Freight on Board (FOB) Australia, whilst the others are thought to be Cost, Insurance and Freight (CIF) China; in which case subtract $50 to $100/t to arrive at an FOB Australia price.

### 3.2 Mining And Processing

Typical NSW operations comprised a dredge in a mining pond that pumped a sand/water slurry to a floating concentrator where oversize was rejected and the heavy minerals recovered by gravity separation methods. The tailings were deposited behind the concentrator and bulk HM concentrate was pumped ashore to a stockpile where the moisture was allowed to drain out. Plant capacities ranged from say around 200 tonnes/hour to approaching 2,000 tonnes/hour.

Beyond the dredge/floating concentrator arrangement described above there were a range of alternative mining methods, for instance:

- A dredge floating in a small pond pumping back to a skid mounted concentrator.
- A “pot hole” (non-floating or skid mounted) dredge set up on the side of a hole into which a bulldozer pushed the sand to the “pot hole”.
- In the case of the highly indurated (heavily cemented) sands of the north coast, track mounted bucket well excavators.

These plants tended to be of smaller throughput and were used on small, generally higher grade deposits. Capacities were generally in the range 100 to 500 tonnes/hour.

Bulk concentrates from these operations were trucked to a Mineral Separation Plant (MSP), which as the name implies, separated the minerals out into their separate species, normally rutile and zircon however sometimes also ilmenite and monazite.

Major operators such as RZM, MDL and Associated Minerals (later Renison Goldfields, now part of Iluka) tended to have a single MSP or a single MSP for a given area, fed by a number of concentrators. They also tended to have a number of plants with a range of capacities that were used as required. For instance, larger capacity dredge/floating concentrator plants for large low grade resources and dredge/skid mounted concentrator plants for smaller, higher grade resources. These latter plants could be readily dismantled and moved to a new site.

## 3.3 Rehabilitation

Topsoil, along with vegetation was removed ahead of mining, the tailings re-contoured post-mining and the topsoil replaced. NSW regulations specify that 300mm of topsoil must be removed.

A number of rehabilitation strategies were employed. For native forests the most successful approach was proposed by Warren Atkinson of the Soil Conservation Service of NSW and first applied on the RZM Tomago Sands Project in 1972/'73. Rather than burning the vegetation first and then removing the top soil, it involved pushing the topsoil aside, complete with vegetation, and pushing the mass back post-mining and allowing natural regeneration to take place.

This avoided problems with heavy fertilization, planting with non-native grasses and heavy supplementary planting that was required by previous methods and yielded much faster regeneration. Regardless of its success, it was initially strongly opposed by the conservation movement as being too cheap.

## 3.4 Mining Target Areas

Historically the focus for HM sand mining was primarily on Crown Lands, however the increasingly powerful conservation movement targeted the East Coast industry and gradually, during the 1970's and 1980's, coastal Crown Lands hosting HM resources were converted to National Parks. The result was a gradual sterilisation of resources and a decline of the industry on the east coast.

The last NSW producer was Mineral Deposits Ltd who ceased operations on the Stockton Dune system around 2003. Sibelco (formerly Consolidated Rutile Ltd) still have a large capacity (up to 2,800 tonnes/hour) dredging operation exploiting the Aeolian dunes on Stradbroke Island, north of NSW/QLD border. The bulk HM concentrate is barged to an MSP on the mainland at Pinkenba, a suburb on the Brisbane River.

With the decline of the NSW industry, operations that had commenced in WA in the 1950's expanded through the 1960's to 1990's till WA became a world player. The mineralogy of the WA HM suites differed from those of NSW being much richer in low chrome ilmenite.

A secondary industry grew up around the WA mineral sands operations with plants producing synthetic rutile and titanium dioxide pigments from ilmenite.

With remaining WA resources nearing exhaustion or sterilised in national parks there is currently a move to the Tertiary Age mineral sands accumulations in the Murray Basin.

### 3.5 Problems In Resource Evaluation

Returning to the 1970's/1980's, PHSA, were project co-ordinators for the RZ Mines (Newcastle) Pty Ltd (RZM) Tomago Sand Beds project in 1972/1973 and subsequently expert witnesses in a 1983 major court case over exploration carried out on an area known as Viney Creek, north of Tea Gardens.

The Tomago Sand Beds hosted a very high grade resource which yielded 10% HM recoveries for the first year of operation whilst, due to early plant inefficiencies, leaving sufficient minerals in the tailings to allow them to be profitably re-mined. Viney Creek had been considered to host a small +1% HM sand resource.

On the basis of this experience PHSA became aware that the drilling techniques generally in use up to that time, and in some cases also the assaying techniques, tended to downgrade HM determinations for wave concentrated resources. The result was to make large low grade resources invisible.

The problem arises out of the fact that wave concentration in storm events results in narrow bands of high grade HM (bands say 50mm thick containing up to 70% HM) separated by much wider intervals of barren sand, see Rattigan JH and Stitt PH, (1990).

By way of example, consider a drilling programme where the theoretical recovery weight should be 7kg of sand per 2m interval drilled. If say 14kg is recovered for a particular interval the question then is: where did the extra 7kg come from. If uniformly down the hole there is no problem, however if from a particular point (say where there is a rod change) the problem becomes one of knowing whether the extra weight came from a mineral rich or a mineral poor interval. Since the mineral rich bands are narrow and separated by much wider intervals of barren sand, statistically the most likely result will be to dilute the sample with 7kg of barren sand and ultimately halve the HM estimate for the particular interval.

In those days, recovery of double the theoretical quantity of sand per interval drilled was not uncommon, in fact instances of recoveries of 2, 3 and up to 10 times the theoretical weight were a feature of some poorly executed drilling programmes. This led to massive downgrading.

The realisation that this situation existed, led to Viney Ck being re-drilled with tight control on weights recovered per interval drilled and careful assaying of the samples. The application of these concepts led to it being recognised as a large low grade resource. The project was subsequently purchased by MDL and mined for around 15 years at rates in the range 1,700 to 2,000 tonnes/hour.

### 3.6 A Possible Way Ahead In The 1980's

On the basis of this experience and with the bulk of the remaining East Coast resources in the process of being locked up in national parks and much of the high grade resources mined or in the process of being mined; around the mid 1980's PHSA suggested to Australmin Holdings Ltd (Australmin) that it might be possible to establish a HM sand mining operation largely on freehold land and re-drilling possible targets using more appropriate drilling and assaying techniques. This led to Australmin commissioning PHSA to design a series of exploration areas along the NSW coast from the Myall Lakes north to the Queensland border. These areas were applied for by Australasian Mining Titles Pty Ltd on behalf of Australmin.

The NTDP Site was covered by EL 3066, issued to Australmin Pacific NL on 24 February 1988. However Australmin found itself heavily engaged in the Company's northern title areas and farmed out the southern EL's (including EL 3066) to R.Z. Mines (Newcastle) Pty Ltd (RZM) in a joint venture agreement under which RZM acted as the operator.

Australmin had acquired and refurbished the Northern Rivers Rutile/Dillingham MSP at Woodburn and set out to establish a dredge/floating concentrator mining operation at Newrybar, North of Ballina. Unfortunately a change in management led to changes in approach and the construction of a plant not capable of handling the heavy induration common in that part of the world. At this stage Australmin was taken over by a company interested in its WA gold project and with no background in mineral sands. As a consequence Australmin's loss making mineral sands operation was shut down without much attempt to resolve its technical problems.

RZM for its part subsequently added an additional area adjacent and to the north of EL 3066 (EL 3012) and carried out extensive exploration over the two tenements. In the final analysis RZM relinquished both EL's without establishing a mining operation on the NTDP Site. However their exploration work extended into the Site and the Company's exploration reports are the best source of information in respect to the HM sands mining potential of the Site.

These reports largely underpin this document and are listed in Section 8, References.

## 4. EXPLORATION ON THE NTDP SITE

### 4.1 Early Work

There has been exploration and mining on the lands covered by EL 3066, prior to the tenement being issued in 1988. However the records of these operations appear to be irrelevant for the current exercise and so they have been ignored for the purposes of preparing this report.

### 4.2 Exploration By RZM

RZM's drilling on EL's 3012 and 3066 was by hand boring and Reverse Circulation (RC). Hand boring makes use of hand augers above the water table and cased sludging gear below the water table. The technique is limited as to depth (10m is a practical limit) and the nature of the ground. However for wave concentrated resources, such as those most likely to be encountered on the NTDP site, and with an experienced crew it can yield the most accurate results. This judged on the basis of control of weight recovered per interval drilled.

In addition the gear is hand portable and so can be used on sites inaccessible to other methods; e.g. swamps.

Reverse Circulation is a technique that makes use of a drill rig set up with concentric drilling rods and an air compressor. Compressed air is sent down the annular space between the inner and outer tube and returns to the surface via the inner tube bringing the material cut by the bit, with it.

It has a much greater depth capability than hand boring, is much faster and can handle much more heavily cemented (indurated) ground than hand boring. However in ground favourable to hand boring it is not as accurate and is subject to much greater downgrading if not carefully controlled.

Unit costs ($/m drilled) for both methods are often close.

RZM state that "*..hand drilling was conducted in areas of poor accessibility and/or to define shallow high grade mineralisation.*", Correia K.(1994). The equipment comprised 75mm sand/clay augers above water table and 50mm diameter cased sludging gear below the water table. Sampling intervals were 0.5m and 1m. And the samples were cone and quartered before sending them for HM assay.

RC drilling made use of 3m long AQ rods (48mm hole diameter) and a 1.5m sampling interval was used. The entire sample was sent for HM assay.

No comment has been located on whether or not there was monitoring of sample weights recovered per interval, drilled.

Traverse lines were, as per stand practice, normal to the axis of any strandline being drilled and the hole spacing nominally 20m, but occasionally decreased to 10m to more closely define mineralisation boundaries, or opened up to 40m in a reconnaissance situation.

RZM determine HM content (grades) in a somewhat different manner than do most of the industry, they use kilograms of HM per cubic metre ($kg/m^3$) rather % HM. Notwithstanding this, at least one RZM report, Wollen S.R. (1991) in referring to two resources, gives cut-off grades in %HM and resource estimates in terms of both $kg/m^3$ and % HM.

A first pass comparison between the two methods is set out in Table 4.1, assuming in situ sand bulk densities of 1,600 and 1,800 $kg/m^3$. The increase in bulk density due to increasing percentages of HM is ignored.

**TABLE 4.1**

**A Comparison Between Recording HM Grades As % HM And As Kilograms Of HM Per Cubic Metre (kg/m$^3$) For Two In Situ Sand Densities**

| HM (kg/m$^3$) | % HM @ 1,600 kg/m$^3$ | % HM @ 1,800 kg/m$^3$ |
|---|---|---|
| 5 | 0.31 | 0.28 |
| 10 | 0.63 | 0.56 |
| 15 | 0.94 | 0.83 |
| 20 | 1.25 | 1.11 |
| 25 | 1.56 | 1.39 |
| 30 | 1.88 | 1.67 |
| 35 | 2.19 | 1.94 |
| 40 | 2.50 | 2.22 |
| 45 | 2.81 | 2.50 |
| 50 | 3.13 | 2.78 |
| 55 | 3.44 | 3.06 |
| 60 | 3.75 | 3.33 |
| 100 | 6.25 | 5.56 |

A bulk density of 1,600 kg/m$^3$ is typical for loosely backed and closely sized, clean, quartz sand. In situ bulk densities would normally, but not always, be somewhat higher, say closer to 1,800 kg/m$^3$. However as there are indications that RZM used a bulk density figure of 1,700 kg/m$^3$ for EL's 3066 and 3312, Wollen S.R. (1991); 1,700 kg/m$^3$ has been adopted for the purposes of this report.

A review of RZM's exploration on EL 3066 shows that eleven traverse lines run into the NTDP site (see Fig.2). Hole spacing along these lines was mostly 20m with limited infill drilling giving a hole spacing of 10m at some locations.

Line 8 virtually crosses the site, whilst Lines 9, 11 and 13 go most of the way across. A review of the assay data indicates the presence of a number of strandlines (ancient beaches) parallel to the current beach. These strandlines are shown in Fig. 2. All are mineralised to a relatively shallow depth (say 2 to 7m) and the largest strandline with the highest grade is the denoted as "Eastern Strandline" in Fig 2.

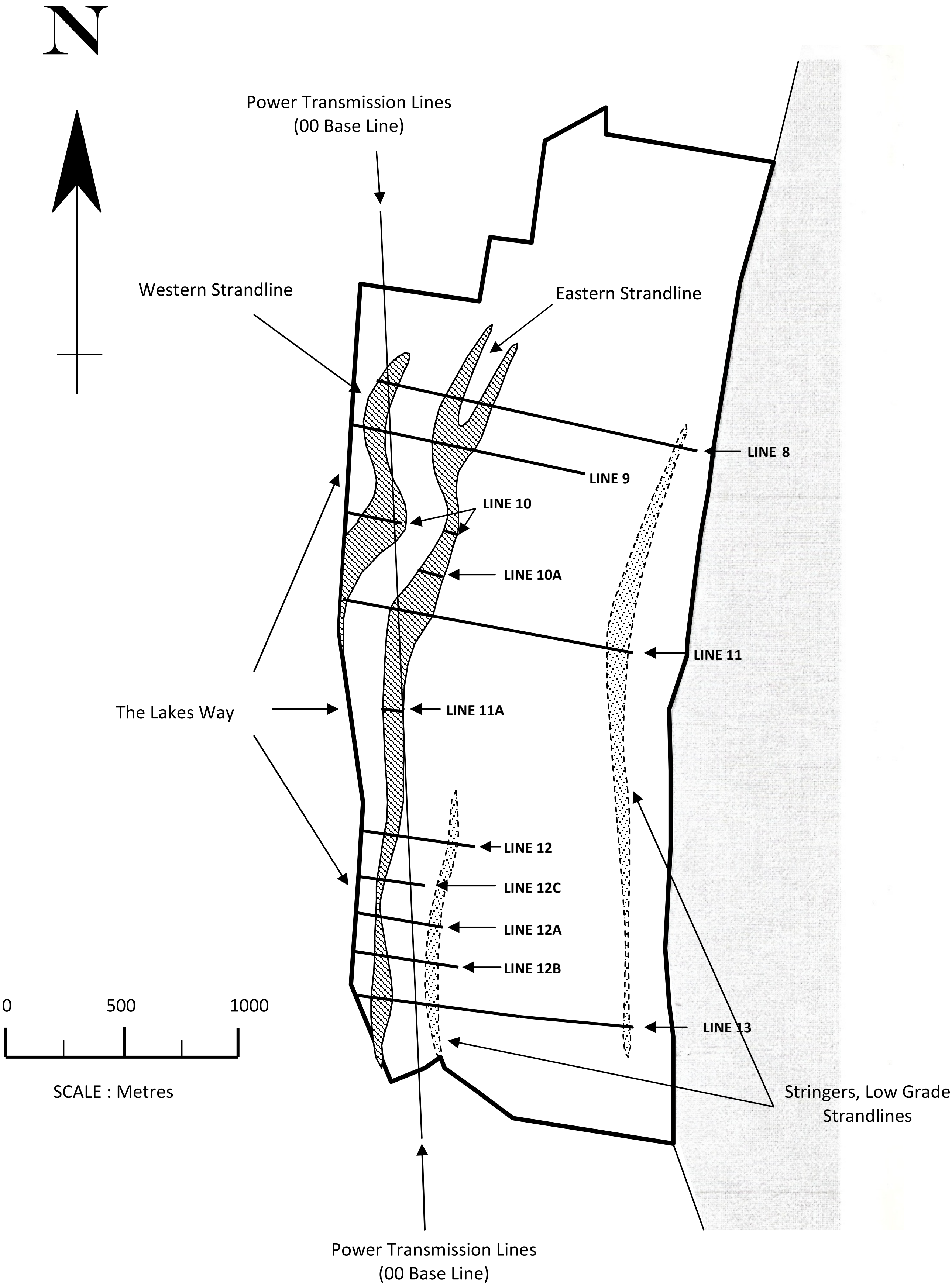



Figure 2: The NTDP Site showing the relationship of the Site boundaries to Strandline development and the RZM drilling traverse lines

An even larger strandline lies substantially to the west of the NTDP site but only just impinges on the Site to the north-west. It is denoted “Western Strandline”.

The area covered by EL’s 3066 and 3312 had been subject to previous mining, the idea behind taking out these particularly tenements was to look for remnant mineralisation, particularly mineralisation that had been overlooked as a result of down grading due to lack of weight control during drilling. It does appear that RZM were successful in locating a number of viable resources (outside the NTDP Site), however all seem to have been relatively small, which probably accounts for the relatively high cut-off grades adopted, 0.75% and 1% HM, Wollen S.R. (1991).

With the possible exception the present day beach, the NTDP site does not appear to have been subject to mining.

### 4.3 Resource Estimates

A first pass resource estimate was carried out on the basis of the RZM data and adopting a cut-off grade of 5kg/$m^3$ (0.3%) Lateral boundaries were placed at/on hole locations along the traverse lines falling within the 5kg/$m^3$ cut-off and the depth determined by the number of drill hole interval samples it was possible to include without dropping below the cut-off.

The resource was divided into discreet blocks between adjacent traverse lines:

Block Area x Average Depth x Bulk Density = Tonnes of sand/block

Grades were averaged from the adjoining traverse lines.

This work indicates that within the boundaries of the NTDP Site the Eastern and Western strandlines between them, host resources, in round terms of:

| | |
|---|---|
| Eastern Strandline | 2,100,000t @ 11.9 kg/$m^3$ |
| Western Strandline | 900,000t @ 9.2 kg/$m^3$ |
| **TOTAL** | **3,000,000t @ 11.1 kg/$m^3$ or 0.7% HM** |

There are uncertainties with these estimates due to factors such as:

- Scaling off small maps.
- The size of setbacks and batters that would be applied along the roads to the west of the NTDP Site (Manning St/Lakes Way). None were allowed.
- The precise location of the base line.
- Environmental constraints.
- The presence of the Tuncurry Country Club which has been ignored.
- Assumptions made in respect of the make-up of the HM suite (see below).
- Restrictions that might apply due to the presence of a power line.
- The presence of housing development to the west of Manning St/Lake Way and directly opposite the NTDP Site and the southern end of the main western strandline.
- The presence of the Tuncurry Midge Orchid (listed as 'critically endangered' under both State and Federal legislation) on the NTDP Site and impinging on the Eastern Strandline. See Fig 3.
- Dilution that may occur due to the presence any of the shallow resources being above the water table.

Under the circumstances the estimates should be considered Inferred Resources under the Joint Ore Reserves Committee (JORC) Code.

The Joint Ore Reserves Committee (JORC) Code is the Australasian code for the reporting of exploration results, mineral resources and ore reserves. It has international standing. Under the Code there are Inferred, Indicated and Measured Resources in increasing order "*…of geological knowledge and confidence.*" By definition:

"*An 'Inferred Resource" is that part of a Mineral Resource for which tonnage, grade and mineral content can be estimated with a low level of confidence. It is inferred from geological evidence and assumed but not verified geological and/or grade continuity. It is based on information gathered through appropriate techniques from locations such as outcrops, trenches pits, workings and drill holes which may be limited or of uncertain quality and reliability.*"

Under the JORC Code the uncertainties are considered to be so great that an Inferred

Resource cannot be converted to a Reserve. By definition:

"*An 'Ore Reserve' is the economically mineable part of a Measured and/or Indicated Mineral Resource. It includes diluting materials and allowances for losses, which may occur when the material is mined. Appropriate assessments and studies have been carried out, and include consideration of and modification by realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors. These assessments demonstrate at the time of reporting that extraction could reasonably be justified. Ore Reserves are sub-divided in order of increasing confidence into Probable Ore Reserves and Proven Ore Reserves.*"

Nonetheless given current commodity prices, grades of in the order of 0.70% would be interesting, the problem is the small size of the resource.

The small strandline (stringer) to the east (see Fig 2) hosts maybe an additional 700,000 tonnes of sand at a grade of around 5 kg/m$^3$ (say 0.3% HM); that is at around the assumed cut-off grade. It is not likely to be economic.

RZM provide no break down on the mineralogy of the heavy mineral suite, however a reasonable assumption would be rutile 24%, zircon 24% and ilmenite 15%. If we further assume a concentrator recovery of 95% and an MSP recovery of 95% (overall recovery 90%) with 60% of the ilmenite recovered to a low chrome product, recoveries for each mineral will be around:

| | | |
|---|---|---|
| Rutile | = | 4,500 tonnes |
| Zircon | = | 4,500 tonnes |
| Ilmenite | = | 1,700 tonnes |

If we next apply the prices set out in Table 4.2 we get an estimated in situ value of something in the range of A$14,000,000 to A$23,000,000, assuming parity between the Australian and the American dollar.

**TABLE 4.2**

**Commodity Prices Assumed – CIF China**

| Mineral | Mid Point Of May 2011 Prices US$/t | December 2011 Spot Prices US$/t |
|---|---|---|
| Rutile | 900 | 2,000 |
| Zircon | 2,100 | 3,000 |
| Ilmenite | 150 | 400 |

Although there may be additional resources it is also true that these estimates of in situ value may be optimistic by virtue of a range of factors; e.g. the magnitude of the resource available for mining, the grades, the mineralogy assumed and indeed the prices adopted.

Even given the uncertainties expressed above, in situ values in the range $14M to $23M appear encouraging, until costs are considered. As noted in Section 5.1 there are no operators left on the NSW coast, therefore a plant would have to be built from scratch. A first pass estimate for a small (say 150t/hr) dredge/floating concentrator plant plus an MSP is $8,500,000. To this must be added infrastructure costs (e.g. power to site) and front end costs (exploration, metallurgical test work, permitting etc). And then there are the operating costs.

So although in situ values look encouraging, when costs are considered it would seem unlikely that a viable operation could be established.

These issues are examined in more detail in Section 5, Financial Model and in Section 6, Discussion.

## 5. FINANCIAL MODEL

### 5.1 Preamble

As things currently stand there is no operator on the NSW coast with an MSP and a dredge/concentrator plant that could exploit the NTDP site, even if an economic resource were demonstrated to exist. The closest would be Tironz Pty Ltd a private company currently investigating the possibility of re-establishing an Australmin type operation in the Ballina – Woodburn area.

In view of this situation and assuming that it is possible to demonstrate the presence of a viable resource; the options for establishing an operation on the NTDP site would seem to be:

i) Construct and commission say, a dredge/floating concentrator plant, plus an MSP and export specification minerals through the Port of Newcastle.

ii) Construct and commission say, a dredge/floating concentrator plant, and truck the bulk concentrate to Sibelco's Pinkenba MSP for processing.

iii) Construct and commission say, a dredge/floating concentrator plant and export a bulk concentrate through the Port of Newcastle.

A financial model was constructed to test Case iii). Omitting an MSP significantly reduces capital requirements and as there is currently a strong demand for heavy mineral bulk concentrates, mainly from China; this approach was adopted, see also Section 9.5.

Financial modelling for the purposes of this exercise is at a **CONCEPTUAL FINANCIAL SCOPING STUDY** level; based on available information as to the resource, the environmental problems likely to be encountered and issues such as the preliminary nature of the capex/opex estimates. It has been prepared in order to obtain an appreciation of whether an HM mining project on the NTDP site might be financially viable and; where the sensitivities might lie.

The model assumes a dredge operating in a small mining pond, feeding back to a skid mounted concentrator that produces an 85% HM concentrate that is shipped off to China by the container load. Plant throughput is assumed to be 150 tonnes/hour. Even with this modest capacity a 3,000,000t resource would be mined out in under four years.

The inputs to the model are detailed in Section 9, Appendices and are summarised blow.

### 5.2 Capital Cost Estimates

The capital cost estimates are detailed in Appendices 9.2 and 9.3 and summarised in Table 5.1 below:

**TABLE 5.1**

**Capital Cost Estimates For A Conceptual Feasibility Study**

| ITEM | COST ESTIMATE $ |
|---|---|
| Stage 1 Investigations | 400,000 |
| Stage 2 Investigations | 300,000 |
| Stage 3 Investigations | 1,400,000 |
| Dredge + Skid Mounted Concentrator | 5,000,000 |
| Infrastructure Items (roads, power to site etc) | 1,000,000 |
| **Grand Total** | **$8,100,000** |

Front end costs cover expenditure incurred prior to the start of plant construction. It includes all expenditure from resource assessment, environmental assessment, through to the preparation of a final feasibility study and completion of the permitting process. A three stage process is assumed:

Stage 1 Exploration And Resource Estimation

Stage 2: Metallurgy, Preliminary Capex/Opex Estimates And Pre-feasibility Study

Stage 3: Final Feasibility Study, Environmental Assessment And Permitting.

A detailed breakdown is given in Section 9.2. Note that the front end costs have been capitalised as shown in Table 5.1.

### 5.3 Operating Cost Estimates

The operating cost estimates are detailed in Appendix 9.4 and summarised in Table 5.3, below:

**TABLE 5.3**

**Summary Of Operating Costs**

| Item | Cost ($) And Detail |
|---|---|
| Labour | $916,500/yr |
| Stripping and Mine Services | $0.10/t mined to cover topsoil removal, positioning dead men and relocating mine site services etc. |
| Rehabilitation | $0.10/t mined to cover re-contouring the tailings, replacing topsoil and general rehabilitation. |
| Power | $90/operating hour |
| Fuel for vehicles | Allowed @ $27,000/yr. |
| Sundry Consumables | Allowed @ $1,000/mth or $12,000/yr. |
| Maintenance | 6% on capital cost of plant + infrastructure ($6,000,000), $60,000/yr. |
| Environmental Compliance | Allowed @ $50,000/yr. |
| Truck to Newcastle | Allowed @ $17/t of concentrate. |
| Wharfage and Loading | Allowed @ $10/t of concentrate. |
| Ship to China | Allowed @ $77/t of concentrate |
| Marketing | Allowed @ $5/t of concentrate. |
| Vehicle Leasing and Op costs | Estimated @ $90,000/yr. |
| Insurance | Allowed @ 1% of the capital cost of plant + infrastructure ($6,000,000), $60,000/yr. |
| Tenements, Drilling & QC | Allowed @ $50,000/yr. |
| Administration | Allowed @ 10% of Op Costs. |
| Government Royalty | Allowed @ 4%of net revenue. |

### 5.4 Revenue

Two cases were studied, a most likely revenue estimate per tonne of bulk concentrate and a most optimistic estimate. These cases were based on the pricing data set out in Table 4.2 and the following assumptions:

- Mineralogy of the HM suite as set out Section 4.3, 24% each for rutile and zircon and 15% ilmenite.
- Overall recovery concentrator in Australia and MSP in China, 90%.
- For the high chrome ilmenite, a 60% recovery to a sulphate product.
- The bulk concentrate is 85% HM.
- Chinese MSP charges are $100/t of bulk concentrate.

Details are set out in Appendix 9.5; however the revenue estimates arrived at were:

| | | |
|---|---|---|
| **Most likely estimate** | **=** | **$460/t of HM bulk concentrate** |
| **Optimistic estimate** | **=** | **$870/t of HM bulk concentrate** |

### 5.5 Nameplate Capacity, Commissioning and Ramp-up

It is assumed that the 150t/hr plant operates 24hrs/day, seven days/week at 85% capacity, with a one day per month shut down for maintenance and a two week shut down over Xmas/New Year for holidays and major maintenance. Under this regime name plate capacity becomes:

| | | |
|---|---|---|
| (365-26) x 24 x 0.85 x 150 | = | 1,037,350t of raw feed per year |
| At 150t/hr | = | 6,915.6hrs/yr |
| **Say** | **=** | **6,900hrs/yr** |
| **For** | **=** | **1,035,000t of raw feed per year** |

Commissioning a plant such as this and ramping up to nameplate capacity takes time. The commissioning and ramp-up assumptions made for this financial model are:

**Year 1**

For the first six months the plant operated at 30% of capacity, equivalent to:

| | | |
|---|---|---|
| 1,035,000t x 0.5 x 0.3 | = | 155,250t of raw feed processed. |

For the second six months the plant operates at 60% of capacity, equivalent to:

| | | |
|---|---|---|
| 1,035,000 x 0.5 x 0.6 | = | 310,500t of raw feed processed. |

| | | |
|---|---|---|
| **Total raw feed in Year 1** | **=** | **465,750t** |
| **At 150t/hr** | **=** | **3,105hrs** |

## 5.6 The DCF/NPV Model

The financial assumptions made in constructing the model were:

i) The project is 100% equity funded.

ii) In-house construction.

iii) The model is run in constant dollars.

iv) The model is run exclusive of GST.

v) Discount rate 8%.

vi) The product is an 85% HM bulk concentrate exported to China in containers.

vii) Exchange rate, A$1.00 = US$1.00.

viii) The financial model runs at reduced capacity for Year 1 (the commissioning and ramp-up year) and then at full nameplate capacity until the resource is exhausted; which happens part way through Year 4.

ix) The working capital is equivalent to 3 months operating expenditure, with the plant operating at name plate capacity.

x) At the end of Year 4 the plant is sold, decommissioning costs paid out of the proceeds, the balance added to revenue, the working capital recovered and the resultant sum discounted back to present.

xi) Net proceeds from sale of the plant, after de-commissioning costs, assumed as $2,000,000.

xi) Depreciation, straight line 25%.

xii) Company tax, 30%.

xiii) NSW State Government royalty, 4% of ex-mine value.

The base case, following common industry practice, is run as 100% equity funded.

This is a Conceptual Financial Scoping Study aimed at obtaining an appreciation of whether a stand-alone project might be viable. For say, a Final (Bankable) Feasibility discount rates would be normally be determined using the Capital Asset Pricing Model approach. A simple approach for a preliminary study is to add the current inflation rate (about 3.7%) to the risk free interest rate. For a short lived project such as this the risk free rate was taken as the current RBA rate (4.25%) total 3.7% + 4.25% = 7.95%, say 8%.

Spreadsheets were prepared on the basis of these assumptions for both the $460/t of bulk HM concentrate revenue estimate (Case A) and the $870/t estimate (Case B). They appear as Tables 5.4 and 5.5.

**On the basis of the assumptions made, both yield negative NPV's, in round figures:**

| | | |
|---|---|---|
| **Case A** | **=** | **-$7,500,000** |
| **Case B** | **=** | **-$460,000** |

**That is the project loses between $460,000 (Case B) and $7,500,000 (Case A).**

TABLE 5.4

LANDCOM - NORTH TUNCURRY DEVELOPMENT PROJECT

## CASE A Preliminary Financial Scoping Study 150 TPH Dredge + Concentrator

| | | | | | YEAR | | |
|---|---|---|---|---|---|---|---|
| | | | 0 | 1 | 2 | 3 | 4 |
| **Revenue** | $/t | | | | | | |
| Operating hrs/yr | | | | 3,105 | 6,900 | 6,900 | 3,000 |
| Tonnes Mined | | | | 465,750 | 1,035,000 | 1,035,000 | 464,000 |
| Bulk Cons (t) | | | | 3,644 | 8,097 | 8,097 | 3,630 |
| | | | | | | | |
| Bulk Cons @ US$460/t | | 460 | | 1676152 | 3724782 | 3724782 | 1669854 |
| | | | | 0 | 0 | 0 | 0 |
| Total Revenue US$ | | | | 1676152 | 3724782 | 3724782 | 1669854 |
| Exchange Rate | | | | 1.0 | 1.0 | 1.0 | 1.0 |
| Total Revenue A$ | | | | 1676152 | 3724782.35 | 3724782.35 | 1669854.12 |
| | | | | | | | |
| **Op Ex** | | | | | | | |
| Labour | | | | 916,500 | 916,500 | 916,500 | 412,425 |
| Move Costs | | | | 0 | 0 | 0 | 0 |
| Bulk Cons, Load & Haul | | | | 0 | 0 | 0 | 0 |
| Stripping $0.10/t | | $0.10 | | $46,575.0 | $103,500.0 | $103,500.0 | $46,400.0 |
| Rehabilitation $0.1/t | | $0.10 | | $46,575.0 | $103,500.0 | $103,500.0 | $46,400.0 |
| Power $90/operating hour | | | | $279,450.0 | $621,000.0 | $621,000.0 | $270,000.0 |
| | | | | 0 | 0 | 0 | 0 |
| Fuel for Vehicles | | | | 27,000 | 27,000 | 27,000 | 12,150 |
| Sundary Consumables | | | | 12,000 | 12,000 | 12,000 | 12,000 |
| Maintenance 6% on $6,000,000 | | | | 360,000 | 360,000 | 360,000 | 162,000 |
| Landholders Compensation | | | | 0 | 0 | 0 | 0 |
| Environmental Compliance | | | | 50,000 | 50,000 | 50,000 | 22,500 |
| Packaging | | | | 0 | 0 | 0 | 0 |
| Truck to Newcastle | $17/t | | | 61945 | 137655 | 137655 | 61712 |
| Wharfage | $10/t | | | 36438 | 80974 | 80974 | 36301 |
| Ship To China | $77/t | | | 280573 | 623496 | 623496 | 280573 |
| Marketing | $5/t | | | 18219 | 40487 | 40487 | 18151 |
| Vehicle Leasing And Op Costs | | | | 90000 | 90000 | 90000 | 40500 |
| Insurance 1% on $6,000,000 | | | | 60,000 | 60,000 | 60,000 | 27,000 |
| Tenements, Drilling & QC - Allow | | | | 50,000 | 50,000 | 50,000 | 22,500 |
| Admin 10% on the above | | | | 233,528 | 327,611 | 327,611 | 147,061 |
| Govt Royalty, 4% of net revenue | | | | 0 | 4842 | 4842 | 2087 |
| Total Expenses | | | | 2,568,803 | 3,608,565 | 3,608,565 | 1,619,760 |
| | | | | | | | |
| Cap Ex | | | 8,100,000 | | | | |
| Working Capital | | | 902,141 | | | | |
| | | | | | | | |
| Pre-tax Profit | | | | -892651 | 116217 | 116217 | 50094 |
| Depreciation 25% on $6,000,000 | | | | 1,500,000 | 1,500,000 | 1,500,000 | 1,500,000 |
| Taxable Income | | | | 0 | 0 | 0 | 0 |
| Tax @ 30% | | | | 0 | 0 | 0 | 0 |
| Cash Flow From Revenue | | | | -892651 | 116217 | 116217 | 50094 |
| Add Back Working Capital | | | | | | | 902,141 |
| Add Back Land | | | | 0 | 0 | 0 | 0 |
| Add Back Sale of Plant After Tax | | | | 0 | 0 | 0 | 2,000,000 |
| Total Cash Flow | | | | -892651 | 116217 | 116217 | 2952235 |
| Discount Factor @ 8% | | | 1.0000 | 0.9259 | 0.8573 | 0.7938 | 0.7350 |
| Discounted Cash Flow | | | | -826528 | 99638 | 92257 | 2169981 |
| Sum Discounted Cash Flow | | | 1535347 | | | | |
| | | | | | | | |
| **NPV** | | | **-7,466,794** | | | | |

**TABLE 5.5**

**LANDCOM - NORTH TUNCURRY DEVELOPMENT PROJECT**

## CASE B Preliminary Financial Scoping Study 150 TPH Dredge + Concentrator

| | | YEAR | | | | |
|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 |
| **Revenue** | $/t | | | | | |
| Operating hrs/yr | | | 3,105 | 6,900 | 6,900 | 3,000 |
| Tonnes Mined | | | 465,750 | 1,035,000 | 1,035,000 | 464,000 |
| Bulk Cons (t) | | | 3,644 | 8,097 | 8,097 | 3,630 |
| | | | | | | |
| Bulk Cons @ US$870/t | 870 | | 3170114 | 7044697 | 7044697 | 3158202 |
| | | | 0 | 0 | 0 | 0 |
| Total Revenue US$ | | | 3170114 | 7044697 | 7044697 | 3158202 |
| Exchange Rate | | | 1.0 | 1.0 | 1.0 | 1.0 |
| Total Revenue A$ | | | 3170114 | 7044697.06 | 7044697.06 | 3158202.35 |
| | | | | | | |
| **Op Ex** | | | | | | |
| Labour | | | 916,500 | 916,500 | 916,500 | 412,425 |
| Move Costs | | | 0 | 0 | 0 | 0 |
| Bulk Cons, Load & Haul | | | 0 | 0 | 0 | 0 |
| Stripping $0.10/t | $0.10 | | $46,575.0 | $103,500.0 | $103,500.0 | $46,400.0 |
| Rehabilitation $0.1/t | $0.10 | | $46,575.0 | $103,500.0 | $103,500.0 | $46,400.0 |
| Power $90/operating hour | | | $279,450.0 | $621,000.0 | $621,000.0 | $270,000.0 |
| | | | 0 | 0 | 0 | 0 |
| Fuel for Vehicles | | | 27,000 | 27,000 | 27,000 | 12,150 |
| Sundary Consumables | | | 12,000 | 12,000 | 12,000 | 12,000 |
| Maintenance 6% on $6,000,000 | | | 360,000 | 360,000 | 360,000 | 162,000 |
| Landholders Compensation | | | 0 | 0 | 0 | 0 |
| Environmental Compliance | | | 50,000 | 50,000 | 50,000 | 22,500 |
| Packaging | | | 0 | 0 | 0 | 0 |
| Truck to Newcastle | $17/t | | 61945 | 137655 | 137655 | 61712 |
| Wharfage | $10/t | | 36438 | 80974 | 80974 | 36301 |
| Ship To China | $77/t | | 280573 | 623496 | 623496 | 280573 |
| Marketing | $5/t | | 18219 | 40487 | 40487 | 18151 |
| Vehicle Leasing And Op Costs | | | 90000 | 90000 | 90000 | 40500 |
| Insurance 1% on $6,000,000 | | | 60,000 | 60,000 | 60,000 | 27,000 |
| Tenements, Drilling & QC - Allow | | | 50,000 | 50,000 | 50,000 | 22,500 |
| Admin 10% on the above | | | 233,528 | 327,611 | 327,611 | 147,061 |
| Govt Royalty, 4% of net revenue | | | 24052 | 137639 | 137639 | 61621 |
| Total Expenses | | | 2,592,855 | 3,741,362 | 3,741,362 | 1,679,294 |
| | | | | | | |
| Cap Ex | | 8,100,000 | | | | |
| Working Capital | | 935,340 | | | | |
| | | | | | | |
| Pre-tax Profit | | | 577259 | 3303335 | 3303335 | 1478908 |
| Depreciation 25% on $6,000,000 | | | 1,500,000 | 1,500,000 | 1,500,000 | 1,500,000 |
| Taxable Income | | | -922,741 | 880,594 | 1,803,335 | -21,092 |
| Tax @ 30% | | | 0 | 264,178 | 541,001 | 0 |
| Cash Flow From Revenue | | | 577259 | 3039157 | 2762335 | 1478908 |
| Add Back Working Capital | | | | | | 935,340 |
| Add Back Land | | | 0 | 0 | 0 | 0 |
| Add Back Sale of Plant After Tax | | | 0 | 0 | 0 | 2,000,000 |
| Total Cash Flow | | | 577259 | 3039157 | 2762335 | 4414248 |
| Discount Factor @ 8% | | 1.0000 | 0.9259 | 0.8573 | 0.7938 | 0.7350 |
| Discounted Cash Flow | | | 534498.665 | 2605587.5 | 2192830.44 | 3244604.31 |
| Sum Discounted Cash Flow | | 8577520.9 | | | | |
| | | | | | | |
| **NPV** | | **-457,819** | | | | |

## 6. DISCUSSION

### 6.1 Preamble

The issues relevant to an assessment of the NTDP Site as a HM sands resource are reviewed, along with the financial model.

### 6.2 Resource Estimates

As noted in Section 4.3 the NTDP Site could host a HM Inferred Resource in the order of:

| | | |
|---|---|---|
| Eastern Strandline | | 2,100,000t @ 11.9 kg/m$^3$ |
| Western Strandline | | 900,000t @ 9.2 kg/m$^3$ |
| | **TOTAL** | **3,000,000t @ 11.1 kg/m$^3$ or 0.7% HM** |

at a cut-off grade of 4.8 kg/m$^3$ or 0.3%.

Given industry history the question arises as to how accurate are the resource estimates set out in Section 4.3 and particularly is it possible that grades have been substantially under estimated. Comment on these issues is therefore warranted.

Heavy Mineral strandlines are generally of fairly simple geometry and hence present few problems in volume determination. Given this situation and allowing for the limited data available for the NTDP site the volume estimates for the NTDP site should be in correct order of magnitude

In addition grades tend to vary gradually along strandlines. On the face of it this should make resource estimation relatively simple, however this was an illusion.

Historically the major errors in resource estimation arose from under estimating grades, as discussed in Section 3.5. Moreover these errors frequently led to substantial under estimation, particularly prior to the events discussed in Section 3.5.

There were numerous instances of a particular resource being mined with recoveries meeting predictions, only to discover that the tailings still contained a viable resource. This typically resulted from a number of factors:

- Grade under estimation.

- Plant inefficiencies in recovering the HM.
- Rejection of oversize containing HM back to the mining pond.

These resources were of course re-mined. On the odd occasion some resources were even mined three times.

As we have seen, the major factor in underestimating grades for wave concentrated resources was poor control of weight recovery per borehole interval; with RC drilling more difficult to control than hand boring. In some instances assay techniques played a part, however problems here affected estimation of all types of resource.

The RZM report data does not include weight information so it is not possible to obtain an indication as to whether poor weight control may have led to downgrading, however there are a number of holes that were drilled both by RC and hand boring. As it is not uncommon, due to weight control difficulties, for RC results to yield significantly lower grade estimates than hand boring; a comparison of HM assay data for the two methods provides an indication of the care taken in drilling.

Accordingly a comparison was made between HM determinations for 30 holes, drilled within the NTDP Site for which there were both RC and hand boring data. However this comparison was complicated by the following issues:

- The sampling interval for RC drilling was 1.5m and for hand boring 1.0m.
- For RC drilling the top 0.3m of topsoil was not sampled. In NSW, 0.3m of topsoil has to be put aside for rehabilitation, so the first sample sent for assay for each hole was 0.3 to 1.5m.
- For hand boring the 0.3m of top soil was nearly always included in the first interval (0 – 1.0m) sample.
- The hand boring holes do not go as deep as the RC holes.

In the final analysis the approach taken was to run the comparison between 0.3m and 5.0m, using weighted average data for the top and bottom intervals.

Results are set out in Table 6.1.

**TABLE 6.1**

**A Comparison Of Grade Determinations Calculated For 30 Holes (0.3 to 5m) Drilled By Both RC And Hand Boring Methods.**

| Hole ID. | RC Grade ($kg/m^3$) | HA Grade ($kg/m^3$) |
|---|---|---|
| Line 8 380E | 2.71 | 2.06 |
| Line 8 400E | 5.97 | 7.42 |
| Line 8 420E | 3.94 | 3.25 |
| Line 8 440E | 7.78 | 6.60 |
| Line 8 460E | 2.82 | 2.46 |
| Line 8 1260E | 8.04 | 7.97 |
| Line 8 1280E | 1.95 | 3.33 |
| Line 9 240E | 2.23 | 2.36 |
| Line 9 260E | 5.73 | 5.49 |
| Line 9 280E | 2.43 | 2.02 |
| Line 9 300E | 2.00 | 1.74 |
| Line 9 320E | 2.50 | 2.66 |
| Line 9 340E | 8.02 | 9.82 |
| Line 9 360E | 5.73 | 3.19 |
| Line 11 00E | 3.67 | 1.65 |
| Line 11 20E | 5.92 | 4.60 |
| Line 11 40E | 2.82 | 2.46 |
| Line 11 60E | 5.98 | 6.06 |
| Line 11 80E | 3.41 | 2.68 |
| Line 11 100E | 28.60 | 37.15 |
| Line 11 120E | 17.96 | 31.75 |
| Line 11 140E | 12.93 | 10.60 |
| Line 11 160E | 1.21 | 1.90 |
| Line 11 900E | 1.47 | 0.89 |
| Line 11 920E | 13.44 | 2.80 |
| Line 11 940E | 2.07 | 2.99 |
| Line 13 540E | 0.74 | 1.16 |
| Line 13 560E | 1.76 | 1.74 |
| Line 13 580E | 1.43 | 1.86 |
| Line 13 600E | 0.87 | 0.58 |
| AVERAGE | 5.54 | 5.71 |

Note: RC Denotes Reverse Circulation (RC) Drilling.
HA Denotes Hand Boring

As can be seem from the Table the average grade for thirty holes was 5.54kg/$m^3$ with RC drilling and 5.71kg/$m^3$ with hand boring; a 3% increase hand boring over RC drilling. This small difference indicates that the RZM work was executed with care and the grade estimates used in taking out the Inferred Resource are unlikely to represent significant downgrading.

As volumes and bulk density estimates are also likely to be reasonable, the Inferred Resource estimate is most likely reasonable, given the data available.

The major issues impinging on the resource estimates are most likely those set out in Section 4.3; re-iterating:

- Scaling off small maps.
- The size of setbacks and batter requirements that would be applied along the roads to the west of the NTDP Site (Manning St/Lakes Way). None were allowed.
- The precise location of the base line.
- Environmental constraints; e.g. those arising from the presence of the Tuncurry Midge Orchid (listed as 'critically endangered' under both State and Federal legislation) on the NTDP Site and impinging on the Eastern Strandline. See Fig 3.
- The presence of the Tuncurry Country Club. Ignored.
- Assumptions made in respect of the make-up of the HM suite (see Section 4.3).
- Restrictions that might apply due to the presence of a power line.
- The presence of housing development to the west of Manning St/Lake Way and directly opposite the NTDP Site and the southern end of the main western strandline.
- Dilution that may occur due to the presence any of the shallow resources being above the water table.

Most of these issues will have the effect of reducing either the magnitude of the resource (e.g. setbacks and the Tuncurry Midge Orchid) or the grade (dilution).

Taking an overview, it appears unlikely that the resource estimates are significantly overstated but that a range of issues (some of which are difficult to predict) could have a negative impact. **On the balance of probabilities the Inferred Resource estimate of 3,000,000t at a grade of 0.7% HM and a cut-off of 0.3% HM is likely to be optimistic, perhaps to a significant degree.**

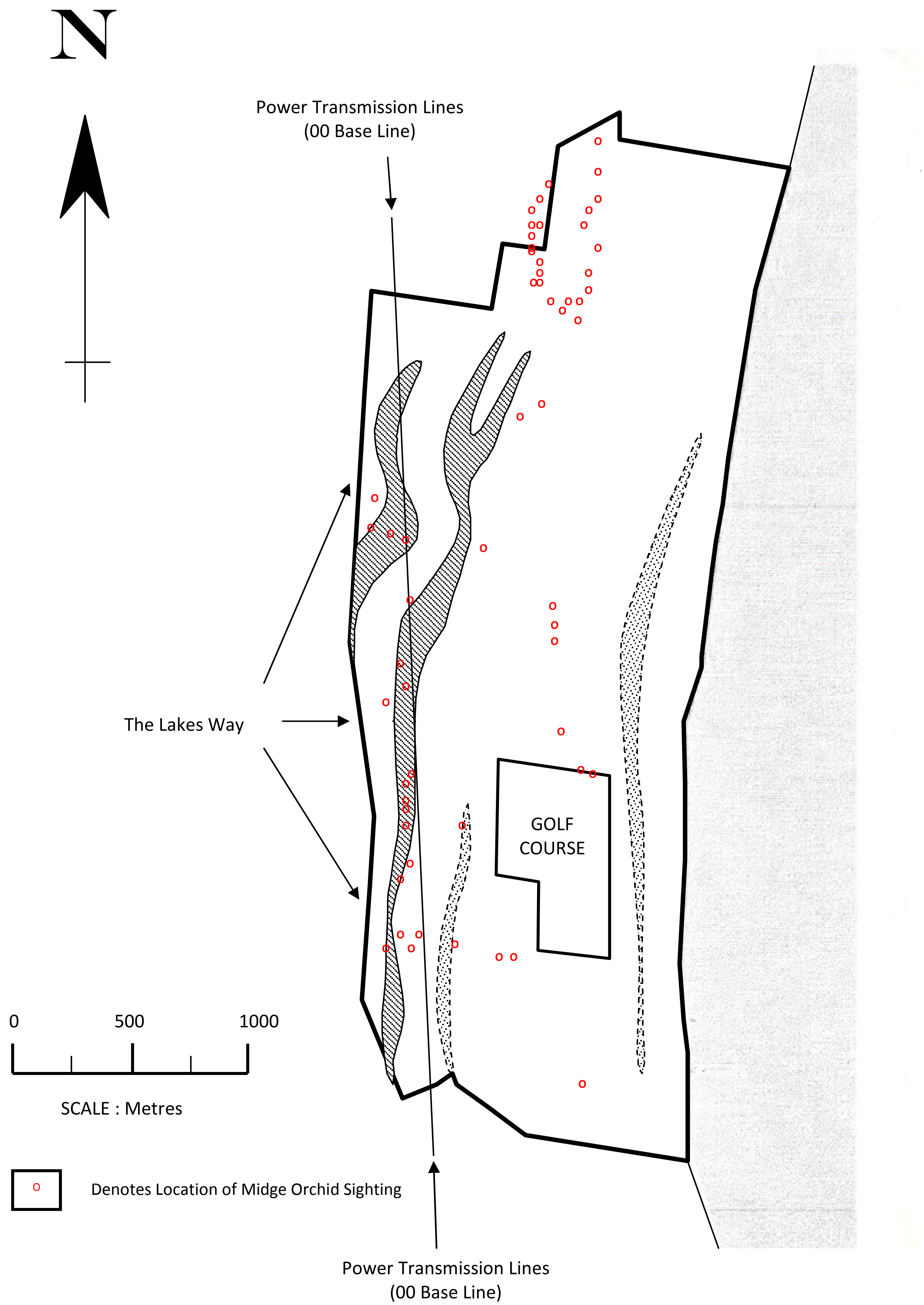



Figure 3: The NTDP Site showing the relative locations of the Golf Coarse, Tuncurry Midge Orchid sightings and Strandlines within Site boundaries

**Putting these resource estimates in the context of Australian production and world resources:**

According to the Australian Atlas of Mineral Resources, Mines and Processing Centres, in 2009 Australia produced:

1. Ilmenite = 1,534,000t
   (the estimate for the NTDP Site is about 0.1% of this)

2. Rutile = 280,000t
   (the estimate for the NTDP Site is about 1.6% of this)

3. Leucoxene * = 160,000t

4. Zircon = 476,000t
   (the estimate for NTDP Site is about 0.9% of this)

* Leucoxene is a weathering product of ilmenite; the chemical composition can approach that of rutile ($TiO_2$).

Australia's estimated reserves as a percentage of the World are stated to be:

1. Rutile = 49%, first in the World

2. Zircon = 46%, first in the World

3. Ilmenite = 19%, second to China.

**From the above it is apparent that regardless of whether the NTDP site estimates are high or low, on the national/international scene, these resources are insignificant.**

### 6.3 Capital Expenditure (Capex) Estimates

Whilst the plant estimates are rough they are probably in the right “ball back”. The same cannot be said of the Front End Estimates, the major difficulty being permitting costs. It is PHSA’s experience that even objections without merit can add greatly and unpredictably to costs and with residential areas and schools close by, it is highly likely that there would be objections to any proposal to mine.

It is further our experience that the very purpose of some protests is to make a project so expensive as to be uneconomic.

The capex estimates could therefore be on the low side.

### 6.4 Operating Cost (Opex) Estimates

Given the scoping nature of this study opex estimates are thought to be reasonable, however, as for the capex estimates, they could be adversely impacted by environmental issues.

In the 1970's RZM's Tomago Sand Beds Project had extremely expensive (and unpredicted) environmental constraints put on it that proved to be totally unnecessary, but added significantly to operating costs.

### 6.5 Financial Modelling

As previously stated the financial modelling for the purposes of this exercise is at a **CONCEPTUAL FINANCIAL SCOPING STUDY** level and is based on limited information.

Two revenue scenarios were studied, one on the basis of what are believed to be realistic commodity prices (CASE A) and the other on optimistic prices (CASE B).

**On the basis of the assumptions made and in round terms both yield negative Net Present Values; CASE A around negative $7,500,000 and CASE B about negative $460,000.**

In a real life situation the available resource is likely to be significantly smaller than estimated due to factors such as setbacks and environmental constraints (e.g. resulting from the presence of the Tuncurry Midge Orchid). In addition, it is likely that the capex estimates, in particular, have been under estimated.

**Although other scenarios could have been examined (e.g. as above but with lower resource estimates, and/or higher capex/opex estimates, and/or higher discount rates and/or with an MSP exporting specification products rather than bulk**

**concentrates) all would have pushed the model further into negative NPV territory. The reality is that the NTDP Site does not host a resource capable of supporting a stand-alone HM sand mining project.**

The problem is that the resource, even as estimated in Section 4.3, is simply too small and too low grade to be viable as a stand-alone project. The question then is, are there other resources that could be exploited so as to create a viable project. Given RZM's thorough work in exploring EL 3066 and in exploiting the small resources that they located in the course of that exploration, this is most unlikely.

### 6.6 The Department Of Primary Industry (the DPI)

PHSA has carried out a number of commissions of a similar nature to this, that is checking whether a particular planned development will sterilise a viable HM sand resource. Most have involved planned upgrades for sections of the Pacific Highway and have mostly resulted from a DPI recommendation.

All the Pacific Highway studies involved drilling which, viewed as mineral exploration, requires taking out an Exploration Licence; a lengthy and sometimes expensive exercise. This problem was avoided by the mutual consent of all the parties involved, treating the drilling as "Site Investigation". The logs were in fact made available for that purpose.

The DPI's prime concern is that a valuable HM sand resource not be sterilised. Beyond that they are not greatly concerned, unless there are indications of a viable resource and application is made for the issue of an Exploration Licence and perhaps subsequently, a Mining Licence.

Contact was made with the DPI over the North Tuncurry Development Project and a preliminary draft of this report provided to them.

### 6.7 RZM

RZM relinquished eastern part of the portion of EL 3066 hosting the NTDP Site prior to March 1991 and the balance around 1993.

A number of comments in the RZM exploration reports in respect to EL 3066 and the NTDP Site make interesting reading.

1. "*A series of 20 Mining Claims and one Private Mining Agreement covering the remnant cons pads along MDL's old tailings were granted during 1993 and operations on them are proceeding. Mining tenure at Wellers and Failford East was also granted during 1993 and a dry mining operation commenced at Wellers (ML1335) in late 1993.*", Correia K. (1994). This mining activity is within EL 3066, but does not impinge on the NTDP Site.

2. "*The eastern margin of the EL revealed minor heavy mineral intersections across to the Wallamba River.*", Gentle N. (1995). This would include the NTDP Site.

3. "*Eastern margin of EL.*

   *The drilling did not show extensive mineralisation or heavy mineral placer strand development. Mineralisation, when present, was recorded and noted to be patchy.*

   *Hand augering at 0.5m intervals tended to record better heavy mineral grades across some lines than others.* ***Mineralisation on the eastern margin of the lease was non-existent.***", Gentle N. (1995). Emphasis added, again this would include the NTDP Site.

These comments, along with early relinquishment of part of the NTDP Site, indicate that whilst RZM's exploration within EL3066 was succeeding in locating viable resources, the Company did not see the Site as a prospect.

## 7. CONCLUSIONS AND RECOMMENDATIONS

**7.1** On the basis of available data the NTDP Site, within its boundaries, could host a heavy mineral (HM) sand Inferred Resource of around 3,000,000t at a head grade of 0.7% HM (around 11kg/m$^3$) and a cut-off grade of 0.3% HM (around 5kg/m$^3$).

**7.2** With current buoyant commodity prices for rutile and zircon the in situ value of this resource is estimated to be in the range $14,000,000 to $23,000,000.

**7.3** On a stand-alone basis (in the absence of an established mining infrastructure) exploiting such a resource would be a costly exercise.

**7.4** The reality is that issues such as boundary setbacks and environmental constraints, particularly the impact of the Tuncurry Midge Orchid (listed as 'critically endangered' under both State and Federal legislation) on the Eastern Strandline will reduce the magnitude of this resource and its value, perhaps significantly.

**7.5** The NTDP Site's proximity to residential areas, schools and sporting facilities and environmental issues such the presence of the Tuncurry Midge Orchid are likely to promote objection to an HM mining project. It is PHSA's experience that objection can sometimes be launched for the specific purpose of marking a project uneconomic. This is particularly the case for mining projects.

**7.6 Regardless of whether the resource estimates are high or low, it should be noted that on the national/international scene, this is an insignificant resource.**

**7.7** A Discounted Cash Flow/Net Present Value (DCF/NPV) Financial Model was constructed at conceptual scoping study level; assuming the resource in 7.1. The model assumed:

- A 150t/hr dredge/ skid mounted concentrator producing a bulk HM concentrate.
- The bulk concentrate shipped to China for further processing into specification zircon, rutile and ilmenite.

**7.8** Revenue was computed for two cases, first on the basis of a set of likely commodity price estimates (CASE A) and a set of optimistic price estimates (CASE B).

**7.9** **In both cases, on the basis of the assumptions made and in round terms the model yielded a negative NPV, negative $7,500,000 for CASE A and negative $460,000 for CASE B. That is, the project would have lost $7,500,000 in CASE A and $460,000 in CASE B.**

**7.10** The issues addressed in 7.4 and 7.5 could push these NPV estimates even further into negative territory.

**7.11** **The conclusion reached from this study is that the NTDP Site does not host a resource capable of supporting a stand-alone HM sand mining project.**

## 8. REFERENCES


Gentle, N. 1996 Exploration Licence No. 3066 Annual Report for the period 24 September to 23 march 1996. Unpublished Company Report No. 04/96.

Gentle, N. 1995 Exploration Licence No. 3066 Annual Report for the period 24 September to 23 March 1995. Unpublished Company Report No. 05/95.

Correia, K. 1994 1994 Exploration Licence Nos. 3066 and 3312 Annual Report for the Period 25 February 1993 to 24 February 1994. Unpublished Company Report No. 2/94.

Correia, K. 1993 Exploration Licences 3066 and 3312. Interim Report on Mineral Exploration for the Six Month Period ending 24 August 1993.

Ricketts, C. 1993 Exploration Licences 3066 and 3312. Report for theTwelve Months Ended 24 February 1993. Unpublished Company Report No. RZM 2/93.

Wilder, K. 1992 Exploration Licences 3066 and 3312. Interim Report on Mineral Exploration for the Six Month Period Ending 24 August 1992.

Wilder, K. 1992 Exploration Licences 3066 and 3312. Report for the Twelve Months Ended 24 February 1992. Unpublished Company Report No. RZM 2/92.

Wilder, K. 1991 Exploration Licences 3066 and 3312. Interim Report on Mineral Exploration for the Six Month Period Ending 23 August 1991.

Wollen, S.R. 1991 Exploration Licences 3066 and 3312. Interim Report on Mineral Exploration for the Six Month Period Ended 24 February 1991. Unpublished Company Report No. RZM 9/91.

Wollen, S.R. 1990 Exploration Licences 3066 and 3312. Report for the Six Months Ended 24 August 1990. Unpublished Company Report No. RZM 21/90.

Forsyth, K.S. 1990 Exploration Licences 3066 and 3312. Report for the Six Months Ended 24 February 1990. Unpublished Company Report No. RZM 7/90.

Rattigan J.H. & Stitt P.H. 1990 Heavy mineral sands. Monograph 17,Geological Aspects of the Discovery of Some Important Mineral Deposits in Australia. The AusIMM.

Forsyth, K.S. 1989 Exploration Licence 3066. Report for the Six Months Ended 24 August 1989. Unpublished Company Report No. RZM 16/89.

Forsyth, K.S. 1989 Exploration Licence 3066. Report for the Six Months Ended 24 August 1989. Unpublished Company Report No. RZM 4/89.

Forsyth, K.S. 1988 Exploration Licence 3066. Report for the Six Months Ended 24 August 1988. Unpublished Company Report No. RZM 7/88.

## 9. APPENDICIES - FINANCIAL MODEL INPUTS

### 9.1 Preamble

Financial modelling for the purposes of this exercise is at a **CONCEPTUAL FINANCIAL SCOPING STUDY** level; based on available information as to the resource, the environmental problems likely to be encountered and etc. It has been prepared in order to obtain an appreciation of whether an HM mining project on the NTDP site might be financially viable and; where the sensitivities might lie.

The model assumes a dredge operating in a small mining pond, feeding back to a skid mounted concentrator that produces an 85% HM concentrate that is shipped off to China by the container load. Plant capacity is assumed to be 150tonnes/hour.

In estimating front end costs (costs incurred prior to project implementation) a three stage programme is assumed, from commencement of exploration through to the preparation of final feasibility study and completion of the permitting process. The stages considered are:

**Stage 1**

Exploration and resource estimation.

**Stage 2**

Metallurgy and pre-feasibility study.

**Stage 3**

Final feasibility study and permitting.

These costs are taken from previous work by PHSA, amended as required for this particular exercise and adjusted for increases in the CPI.

Cost estimates for each of the above stages are set out in Appendix 9.2.

Appendices 9.3 and 9.4 set out the conceptual scoping study capex/opex estimates whilst Appendix 9.5 details the commodity pricing assumptions.

## 9.2 Front End Cost Estimates

### 9.2.1 Stage 1 - Exploration And Resource Estimation

Stage 1 cost estimates for exploration and resource estimation are set out in Table 9.2.1:

**TABLE 9.2.1**

**STAGE 1 COST ESTIMATES**

**Exploration And Resource Estimation**

| Item | | Estimate $ |
|---|---|---|
| Title application expenses - Allow | = | 20,000 |
| Surveying and putting in grid lines - Allow | = | 20,000 |
| Hand boring 1,600m @ $36/m (200 holes to 8m) | = | 57,600 |
| HM determination 1,600 @ $110 ea inc transport | = | 176,000 |
| Mineralogies, 1 every 10th hole, 20 total @ $165 ea including transport etc | = | 3,300 |
| Assays, 1 every 10th hole, 20 total @ $55 ea including transport etc. | = | 1,100 |
| Supervision; allow 20% on the above ($278,000, includes resource estimation) | = | 55,600 |
| Contingencies allow 15% on the above ($333,600) | = | 50,040 |
| **Total** | | **$383,640** |
| **Say** | = | **$400,000** |

### 9.2.2 Stage 2 – Metallurgy, Preliminary Capex/Opex Estimates And Pre-feasibility Study

Stage 2 cost estimates for metallurgical test work and taking out preliminary capital and operating costs estimates and a first pass financial evaluation; are set out in Table 9.2.2.

## TABLE 9.2.2

### STAGE 2 COST ESTIMATES

### Metallurgical Test Work And Preliminary Capex/Opex Estimates

| Item | Estimate $ |
|---|---|
| Preliminary Metallurgical Test work<br>15 days @ $600/day Titanatek/RJR Lab. | 9,000 |
| HM determinations allow 50 @ $110 each | 5,500 |
| Mineralogies allow 20 @ $165 each | 3,300 |
| Assays allow 100 @ $55 each | 5,500 |
| Metallurgical input/report writing<br>120 hours @ $150/hr | 18,000 |
| Bulk sampling – Allow $10,000<br>including transport to Ballina | 10,000 |
| Bulk sample processing and test work.<br>30 days @ $600/day | 18,000 |
| HM determination 50 @ $110 each | 5,500 |
| Mineralogies 50 @ $165 each | 8,250 |
| Assays 100 @ $55 ea | 5,500 |
| Qem – Sem/Scan determinations 20 @ $1,100 ea | 22,000 |
| Metallurgical Input/Flow Sheet<br>Design/Report Writing, 160 hours @ $150/hr | 24,000 |
| Preliminary Capex/Opex Estimates & Financial Evaluation,<br>including report writing, 200 hrs @ $150/hr | 30,000 |
| Feasibility Study<br>200 hrs @ $150/hr | 30,000 |
| Airfares, accommodation, meals, sundries – allow | 10,000 |
| Supervision/Coordination allow 20% on the above ($204,550) | 40,910 |
| Contingencies allow 15% on the above ($245,460) | 36,820 |
| **Total Stage 2** | **$282,280** |

**Say = 300,000**

This relatively modest allowance for metallurgical test work flow sheet development and financial evaluation reflects the fact that there is a wealth of experience in processing NSW coastal HM resources. In addition these resources typically host relatively coarse HM suites that are easy to separate.

### 9.2.3 Stage 3 – Final Feasibility Study, Environmental Assessment And Permitting

Stage 3 cost estimates for the preparation of a feasibility study, environmental assessment and permitting are set out in Table 9.2.3.

**TABLE 9.2.3**

**STAGE 3 COST ESTIMATES**

**Feasibility Study, Environmental Assessment And Permitting**

| Item | Estimate $ |
|---|---|
| Feasibility Study – Refine Capex/Opex data<br>200 hours @ $150/hr | 30,000 |
| Marketing Study - allow | 20,000 |
| Financial Model/Report Writing<br>allow 320 hrs @ $150/hr | 48,000 |
| Environmental Assessment (see Table 9.2.4 below) | 530,000 |
| Permitting and Approvals – Allow | 100,000 |
| Legals - Allow | 200,000 |
| Co-ordinating and supervision allow<br>20% on the above ($1,028,000) | 205,600 |
| Contingencies – allow 15%<br>on the above ($1,233,600) | 185,040 |
| **Total Stage 3** | **$1,316,640** |

**Say = $1,400,000**

Note that, beyond the preparation of the EIS, a total of $300,000 is allowed for permitting, approvals and legal expenses. This is little more than a guess and assumes that the balance of these costs will be taken up by the NTDP project permitting/approvals process.

### 9.2.4 Environmental Assessment

These estimates are based on preliminary discussions with a firm of environmental consultants with a background in the mineral sands industry for a similar project. The resultant cost estimates, included in Table 9.2.3, are set out in Table 9.2.4 below.

**TABLE 9.2.4**

**COST ESTIMATE FOR AN ENVIRONMENTAL ASSESSMENT (EA)**

| Item | Estimate $ |
|---|---|
| Water survey | 100,000 |
| Acid sulphate soils study | 200,000 |
| General soil study | 10,000 |
| Ecological study | 10,000 |
| Heritage study | 10,000 |
| Noise study | 30,000 |
| Air quality study | 20,000 |
| Environmental Assessment, (EA) based on the above | 150,000 |
| **Total** | **$530,000** |

### 9.2.5 Summary Of Front End Costs

Front end cost estimates, through to permitting are summarised in Table 9.2 5 below:

**TABLE 9.2.5**

**Summary Of Front End Cost Estimates**

| Item | Estimate $ |
|---|---|
| Stage 1 | 400,000 |
| Stage 2 | 300,000 |
| Stage 3 | 1,400,000 |
| **Total** | **$2,100,000** |

## 9.3 Capital Cost Estimates

### 9.3.1 Plant Costs

In this conceptual scoping it is assumed that there is no Mineral Separation (MSP) Plant, rather a bulk concentrate is exported to China as this will minimise the capex cost and also probably opex costs. See Section 9.5.

It is further assumed that this bulk concentrate is produced by a dredge feeding to a 150 tonne/hour skid mounted concentrator.

To arrive at a capital cost estimate, a previous estimate for a 500 tonnes/hour dredge floating concentrator plant was adjusted for the change from a floating to a skid mounted concentrator and increase in the CPI. This figure was further adjusted for the capacity scale down from 500 to 150 tonnes/hour by the Six Tenths Rule.

| | | |
|---|---|---|
| 150t/hr Cost Estimate | = | 500t/hr Cost Estimate x $(150/500)^{0.6}$ |
| | = | \$9,500,000 x $(150/500)^{0.6}$ |
| | = | \$4,613,140 |
| **Say** | **=** | **\$5,000,000** |

### 9.3.2 Land And Infrastructure

To the plant estimate set out above a nominal allowance of \$1,000,000 was made for infrastructure items such as power line moves, power to site and site preparation.

### 9.3.4 Total Capital Required

Adding in the front end cost estimates, the plant estimate plus the infrastructure estimate gives the total capital estimate as set out in Table 9.3.4.

**TABLE 9.3.4**

**Total Capital Cost Estimates**

| Item | Cost Estimate<br>$ |
|---|---|
| Stage 1 | 400,000 |
| Stage 2 | 300,000 |
| Stage 3 | 1,400,000 |
| Dredge/Concentrator | 5,000,000 |
| Infrastructure | 1,000,000 |
| **TOTAL** | **8,100,000** |

### 9.4 Operating Cost Estimates

#### 9.4.1 Manning And Labour Coats

**Manning**

Assume 3 x 8 hour shifts/day, manning as tabled below.

| Location | Persons/Shift | Total Persons |
|---|---|---|
| Dredge | 1 | 3 |
| Concentrator | 2 | 6 |
| Concentrator, Day Shift Only | 1 | 1 |
| Spare Hands, maintenance, holidays etc | | 2 |
| Part Time Hand | | 1 |
| Manager | | 1 |
| **Total** | | **14** |

**Labour Costs**

Assume:

1 Manager @ $75,000/yr

1 Foreman @ $60,000/yr

11 Hands @ $50,000/yr.

1 Part time @ $20,000/yr

Labour costs are:

| | | |
|---|---|---|
| 1 @ $75,000 | = | $75,000 |
| 1 @ $60,000 | = | $60,000 |
| 11 @ $50,000 | = | $550,000 |
| 1 @ $20,000 | = | $20,000 |
| **Total Labour Costs** | **=** | **$705,000** |

Plus add on items (holidays, sick leave, superannuation etc) allowed at 30%.

**Say** **=** **$916,500**

### 9.4.2 Stripping/Mine Services/Rehabilitation

These items cover:

1. Stripping overburden ahead of mining

2. Positioning the dead men (anchors) used to manoeuvre the dredge and the floating concentrator.

3. Moving the concentrate stockpiling cyclone and lines as required.

4. Road works around the dredge pond.

5. Moving the power lines as required.

6. Re-contouring the tailings.

7. Replacing to topsoil over the re-contoured tailings.

8. Re-vegetating the mined out areas.

Assume the following cost allowances:

Items 1 to 5, $0.10/t mined.

Items 6 to 8 $0.10/t mined

### 9.4.3 Power

The 500 tonne/hour plant on which this exercise is based had a connected load for the dredge and concentrator of 1,100kw. This was also factored down by the Six Tenths Rule.

| | | |
|---|---|---|
| Connected load, 150t/hr plant | = | Connected load 500t/hr plant x $(150/500)^{0.6}$ |
| | = | 1,100 x $(150/500)^{0.6}$ |
| | = | 534kw |
| Say | = | 550kw |

Assume:

- € In operation the plants draw 80% of connected power.
- € Power costs $0.19/kw hr.

| | | |
|---|---|---|
| Power cost is | = | 550 x 0.8 x $0.19 |
| | = | $83.60/hr |
| Add 5% | = | $4.18/hr for power drawn when the plant is idle (e.g. lights, pumps, welders etc) |
| | = | $87.78/hr |
| **Say** | **=** | **$90/hr** |

### 9.4.4 Fuel For Vehicles

Assume that there is a small second hand bulldozer (Caterpillar D5) at the mine site to work around the dredge pond, move anchors etc; two Toyota diesel twin cab 4WD utes plus a small second hand excavator (Caterpillar 312) to load HM concentrate into containers.

**Consumption**

| | | | |
|---|---|---|---|
| i) | Bulldozer, assume it burns | = | 15L/hr |
| | Assumes it operates 1,000hrs/yr | = | 1,000 x 15 |
| | | = | 15,000 L/yr |
| ii) | Excavator, assume it burns | = | 6L/hr |
| | Assume it operates 1,000hrs/yr | = | 1,000 x 6 |
| | | = | 6,000L/yr |

iii) The two Hi Lux utes. Allow 30,000km/yr each @ 6.5km/L

| | | |
|---|---|---|
| | = | 2 x 30,000/6.5 |
| | = | 9,230L/yr |
| Say | = | 9,500L/yr |

Therefore total consumption is:

| | | |
|---|---|---|
| Bulldozer | = | 15,000L/yr |
| Excavator | = | 6,000L/yr |
| 2 x Hi Lux Utes | = | 9,500L/yr |
| **Total** | **=** | **30,500L/yr** |
| **Say** | **=** | **31,000L/yr** |

**Cost**

A price for diesel was estimated on the basis of a previous quote for 5,000L drops adjusted for CPI. This gave a price of $1.25/L and the diesel fuel rebate is close enough to $0.40/L. **The net cost would therefore be $0.85/L or $26,350/yr for 31,000L; say $27,000/yr.**

### 9.4.5 Sundry Consumables

This category is to cover items such as lubricants, and etc.

| | | |
|---|---|---|
| Allow | = | $1,000/mth |
| | = | $12,000/yr |

### 9.4.6 Maintenance

Allow 6% on plant capital, that is on $6,000,000 (see Table 9.3.4).

**6,000,000 x 0.6 = $360,000**

### 9.4.7 Environmental Compliance

This item is to cover ongoing monitoring of the operation and involves environmental monitoring, testing and reporting. A nominal allowance has been made:

= $50,000/yr

### 9.4.8 Trucking to Newcastle/Wharfage/Shipping

These items are based on preliminary estimates, assuming that the bulk HM concentrate is loaded into containers at site for transport to Newcastle. The shipping estimate was provided by a Chinese importer. Estimates are as follows:

| | | |
|---|---|---|
| Transport 155km | = | $17/t concentrate |
| Wharfage/loading | = | $10/t concentrate |
| Ship to China | = | $77/t concentrate |

### 9.4.9 Marketing

Allow $5/t of product.

### 9.4.10 Vehicle Leasing, Insurance and Maintenance Costs

**Capital Cost Estimates**

Assume the following units are leased:

- Two Toyota Hi Lux diesel 4WD manual utes
- One small second hand Caterpillar D5N bulldozer.
- One small second hand Caterpillar 312 hydraulic excavator.

Chatswood Toyota quoted a price on the utes of $45,000 including registration, all on-road costs and GST.

The bulldozer and excavator are considered to be quality second hand units purchased for $150,000 and $90,000 respectively. Total costs then become:

| | | |
|---|---|---|
| 2 x Toyota utes | = | $90,000 |
| Second hand bulldozer | = | $150,000 |
| Second hand excavator | = | $90,000 |
| **Total** | **=** | **$330,000** |

**Leasing**

Chatswood Toyota also gave leasing charges for the utes as described above as $907/mth/vehicle over 4 years with a 30% residual. Assume, as a first approximation, these charges apply to all the equipment. Total leasing charges become:

| | | |
|---|---|---|
| | = | 330,000/90,000 x 907 |
| | = | $3,326/mth |
| | = | $39,908/yr |
| **Say** | **=** | **$40,000/yr** |

**Insurance, Registration and Maintenance**

Allow at 15% of capital per year:

| | | |
|---|---|---|
| | = | 330,000 x 0.15 |
| | = | $49,500/yr |
| **Say** | **=** | **$50,000** |

Total costs of wheeled equipment

| | | |
|---|---|---|
| Leasing charges | = | $40,000/yr |
| Insurance and etc. | = | $50,000/yr |
| **Total** | **=** | **$90,000/yr** |

### 9.4.11 Insurance

Taken as 1% of the capital value of the plant plus infrastructure ($6,000,000); that is $60,000/yr.

### 9.4.12 Tenements, Drilling & QC

This item is to cover such items as reporting, grade control drilling ahead of mining and

Quality Control (QC). A largely arbitrary sum of $50,000/yr has been selected to cover these activities.

### 9.4.13 Administration

Allowed at 10% of the operating cost estimates.

### 9.4.14 Government Royalty

Specified as 4% of net revenue.

## 9.5 Revenue

Currently heavy mineral bulk concentrates are being sold overseas, mainly to China. In fact a failed HM sand project that PHSA is aware of, is being studied by a Chinese/Australian consortium as a revival prospect on the basis of strong commodity prices. Despite having a state of the art MSP it is proving more economical to export bulk concentrate rather than specification products (e.g. rutile and zircon) produced from the MSP.

For the purposes of this exercise it is assumed that bulk HM concentrate is sold to China. Advice was sought as to bulk HM concentrate pricing. A pricing protocol was received that has the effect of placing a higher value on rutile than on zircon. As zircon prices are currently close to double those being achieved for rutile there is obviously a problem.

Under the circumstances the approach taken to determining revenue was to use the Table 1 data to calculate a value on the following assumptions:

- Mineralogy of the HM suite as set out Section 4.3, 24% each for rutile and zircon and 15% ilmenite.
- Overall recovery concentrator in Australia and MSP in China, 90%.
- For the high chrome ilmenite, a 60% recovery to a sulphate product.
- The bulk concentrate is 85% HM.
- Chinese MSP charges are $100/t of bulk concentrate.

As a conservative estimate, a most likely revenue per tonne of bulk concentrate was calculated on the basis of these assumptions, using the mean of the May 2011 prices set out in Table 4.2:

| | | |
|---|---|---|
| Zircon 0.24 x 2,100 x 0.9 | = | \$453.60 |
| Rutile 0.24 x 900 x 0.9 | = | \$194.4 |
| Ilmenite 0.15 x 0.6 x 150 x 0.9 | = | \$12.15 |
| **TOTAL** | **=** | **\$660.15** |
| | | |
| Say | = | \$660/t of HM |

However what is being sold is not 100% heavy mineral rather it is a HM concentrate consisting of a nominal 85% HM plus trash minerals, mainly quartz. Adjusting for this and subtracting the \$100/t processing cost we have:

| | | |
|---|---|---|
| (660 x 0.85) – 100 | = | **\$461/t of bulk concentrate.** |

As a most optimistic case, this exercise was repeated using the December 2011 spot prices from Table 4.2:

| | | |
|---|---|---|
| Zircon 0.24 x 3,000 x 0.9 | = | \$648.00 |
| Rutile 0.24 x 2,000 x 0.9 | = | \$432.00 |
| Ilmenite 0.15 x 0.6 x 400 x 0.9 | = | \$34.40 |
| **TOTAL** | **=** | **\$1,144-40** |

Adjusting again for trash mineral content and MSP charges in China:

| | | |
|---|---|---|
| (1,144 x 0.85) – 100 | = | **\$872/t of bulk concentrate** |