CSIRO - Australia Telescope National Facility

# The ATNF Narrabri Facilities:

## *Summary of three studies to enable the 6-km antenna to be shifted to the main 3-km track.*

### 1. *Introduction:*

With the recent installation of the extra stations on the existing East-west 3-km track and the building of the North spur, the question of being able to periodically shift the isolated antenna on the 6-km site to the main 3-km track was raised. In this report, three possible methods, which have been considered to date, are summarised with sections of reports given in the Attachments. The greatest area of concern, which affects reliability and costs, is the low-lying, flood-prone land between the 3 and 6 km sites.

### 2. *Summary of Methods*

Three methods were considered possible:

a) Hire of specialised multi-wheel platform trailers with hydraulic automated levelling mechanism, and pulled by prime-movers. This method would require one or two days for the shift and the current road to be upgraded and possibly widened if the shift was to be made independent of the weather condition. The short proposal provided by Brambles (see Attachment 1), is costed at $77K for each movement beyond the first, with stand-down costs of $15K per day. There are also, once-off preliminary costs, and cost of any road upgrades to ensure reliability during all weather. Such an approach would be appropriate for antenna shifts, which were only required on rare occasions.

b) A more permanent "in-house" solution by fixing outrigger wheels to the No.6 antenna, with hire of a prime-mover as required. The initial study by Connell Wagner indicated that strengthening of some parts of the antenna base structure would be required. Also, CSIRO's mechanical engineer has carried out some preliminary investigation re suitable wheels and attachment arrangement. The question of road and adjacent area stability would need to be addressed (particularly given the potential problems which could be encountered in long periods of above-average rainfall, eg second half of 1998!). A description of the method is given in Attachment 2. Further design work needs to be done in association with Connell Wagner before cost estimates can be given.

c) The most convenient, reliable and safe system, but most expensive, is using a 3-km low-grade track between the two stations. This method could be readily upgraded by adding more stations between the 3 and 6-km sites if necessary. The preliminary study carried out by Barclay Mowlem (see Attachment 3) gives an estimate of $9.6M, a not-insignificant cost being the need for an extensive network of culverts across the flood-prone low-level land. This approach would provide the safest, quickest and most reliable method of antenna transfer. This total cost would have to be compared with that of a new antenna, if ever a major second upgrade of the facility was undertaken.

Bruce MacA Thomas
February 1999

***Attachment 1***

# Brambles Project Services

# Proposal for on-site move of Telescope

**BRAMBLES** ***Project Services***

An Enterprise of Brambles Australia Limited A.C.N. 000 164 938

25-33 Wilson Street
Botany, NSW 2019
Locked Bag 43
Botany, NSW 2019
Australia
Tel: 61 2 9316 4666
Fax: 61 2 9316 6423

Dr. Bruce Thomas
CSIRO
Vimiera & Pembroke Roads
Marsfield NSW 2122

Ref: Q816
25/5/1998

Re: Proposal for on site move of telescope

Dear Bruce,

Brambles Project Services are pleased to present budgetary costings and scope proposal for the re-location of CSIRO Telescope on site at Culgoora near Narrabri NSW.

**The Telescope**

Described on drawing A.T.P. 103 drawing No. 0602.202 approx dimensions – Dish 22m Dia

| | |
|---|---|
| Height from rail to zenith | 22m |
| Strong point pads | 8m centres |
| Clearance between pads | 7.2m end view |
| Clearance between pads | 6.8m side view |
| All up overall weight | 290 tonnes |

Dish can be rotated horizontal and/or adjusted to alter centre of gravity.

**The Scope**

Pre-planning

To work with Connell Wagner
To prepare transport drawings, they may also include drawings for any frame work alternations, load share breams
Load out site/load in site as deemed necessary
To visit site for purpose of route survey
Possible route upgrading, check measurements

**To Mobilise**

(a) Initial visit

1. 2 x 10 line Nicolas platform trailers with load capacity exceeding not 21 mt per axle line or suitable alternative in our option
2. 2 x 200 tonne load rated matching Mack prime movers
3. Gear trailer with timbers, stools, jacks, steel plate and other assist equipment
4. Crane to assist with assembly of equipment
5. 2 x drivers
   2 x trailer operators
   1 x gear trailer driver/ roustabout

1 x trailer supervisor/ technician
1 x project manager

(b) Subsequent visits
We would delete
- gear trailer
- gear trailer operator/ roustabout
- project manager

**The Job**
One telescope is mounted on rail lines 2m above ground level on a free standing site. This telescope is approx 3 km from a site where five other telescopes are mounted on a single continuous rail track also mounted 2m from the ground.

The single telescope is to be moved from its position 3 km away and placed on the same tracks in line with the other five telescopes.

**The Method**
The ground alongside the load out and load in positions will be prepared if no load share beams required with a concrete pad approx 30m x 8m. This pad will be approx 1.2 metres from rail height. The ground under the telescope will be stabilised with a reinforced end wall below the normal travel stop buffers.

Brambles will manoeuvre the 2 x platform trailers configured as 1 x double wide trailer with corresponding and matching rail lines secured to the deck of the trailer. The trailers will be manoeuvred perpendicular to the rail line with rail line running across the trailer. The rail line will be fitted with stops. The rail line will fitted to a support frame which will clear the trailers on each side by one metre. The trailers will be manoeuvred so that the rail tracks can be butted together. Once aligned and levelled the trailers will be blocked underneath with timber blocks to make a stable platform.

Once in position a winch wire will be attached to the telescope to provide motive power if required and to act as a break.

The telescope will move under its own power from the plinth across on to the temporary rail line mounted on our trailers. Once on board the telescope will be lowered on to its stopes and secured. Stools will have been placed under the support frame either side of the trailer. The trailer will hydraulically raise itself to take the weight of the telescope and to check centre of gravity. At this point the dish can be moved and/or the trailers moved to get final alignment.

Once the parties agree the load is central the telescope will be secured with dogs and chains and deck keepers, positioning of which still to be agreed.

Once all in place the stools and timbers to be removed and the load transferred to its new position where the reverse procedure will take place.

Included in the budgetary proposal:-
- Cost to mobilise men equipment described above
- Allowance for two days on site the first time and one day on site each subsequent move
- Permits and approvals associated with our equipment
- Indemnities and securities for work performance
- Meals and accommodation

Excluded from proposal:-
- Insurance premium costs
- Preparation of load out site/load in site
- Building of support frame with temporary tracks
- Filling in of any ruts/cattle grids and the like
- Delays outside our control including weather (wind and/or rain effected surfaces)
- Removal/replacement of any fences, signs or other obstacles
- Temporary lighting, if required

**The proposal**
To prepare acceptable proposal including site visits, discussions with engineers etc.

A$ 15,000.00

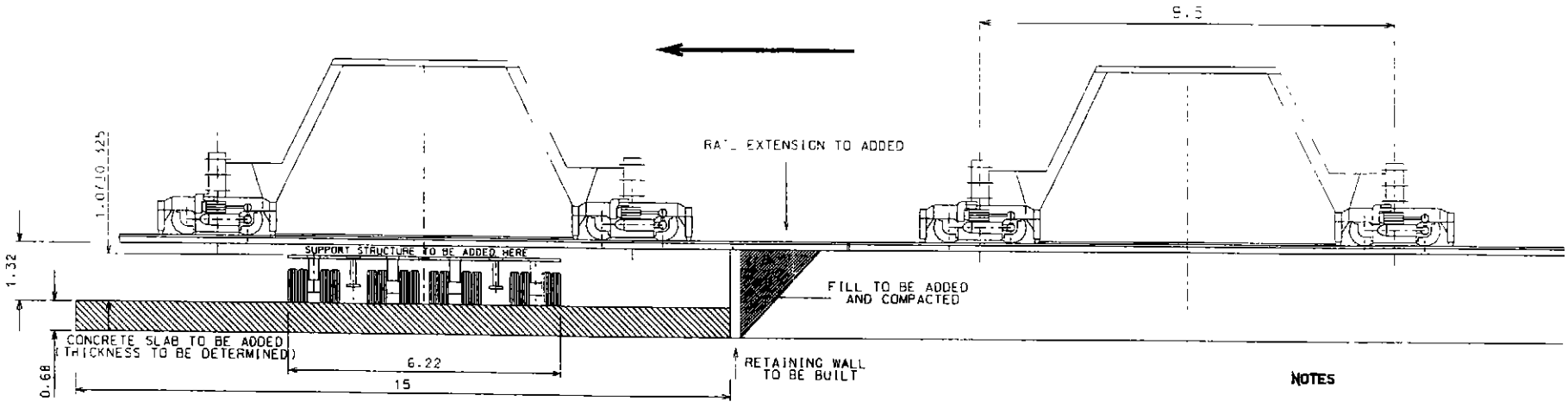
| | |
|---|---|
| The first movement | A$ 95,000.00 |
| Subsequent movements | A$ 77,000.00 |
| Stand down costs | A$ 15,000.00 per day |

Subject to:-
- Final scope of works
- Agreement on terms and conditions
- Availability of equipment at time of order
- Free and unencumbered access to site
- Brambles Project Services standard trading conditions

We trust the foregoing is of interest and look forward to further discussions with a view to concluding an agreement.

Yours faithfully

Graham Owen
**National Manager**

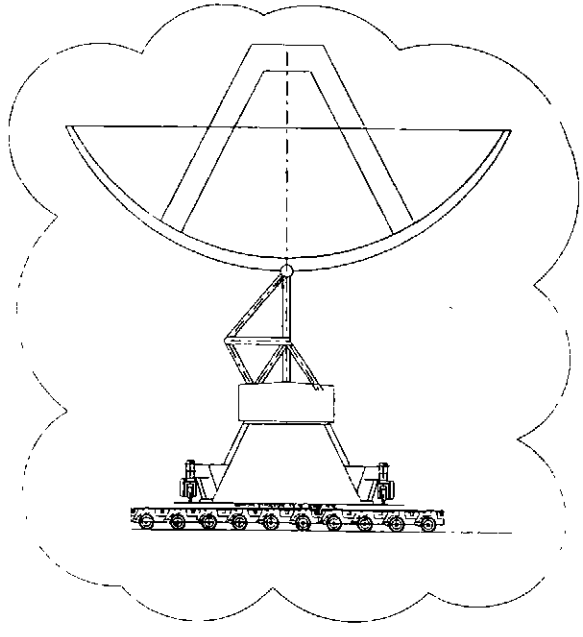


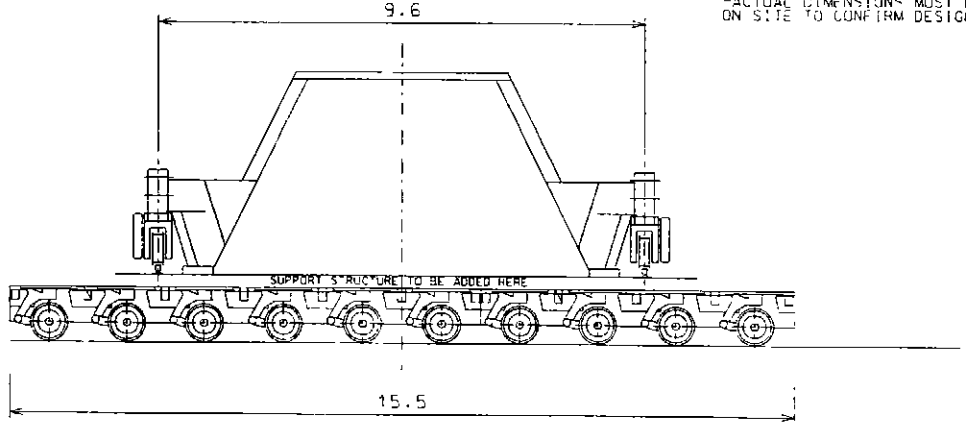

**NOTES**

ALL DIMENSIONS IN METRES

TRAILER CONFIGURATIONS
- 2 X 10 AXLE MODULES

TELESCOPE DIMENSIONS HAVE BEEN SCALED FROM DRAWING PROVIDED
-ACTUAL DIMENSIONS MUST BE MEASURED ON SITE TO CONFIRM DESIGN






| | |
|---|---|
| APPROVED BY | |
| DRAWING STATUS | PRODUCED FOR PRESENTATION |
| PROJECT | TELESCOPE |
| SCALE | NOT TO SCALE |

BRAMBLES Project Services
25-33 Wilson Street Botany, NSW 2019 Australia
Locked Bag 43 Botany, NSW 2019 Australia
An Enterprise of Brambles Australia Limited
A.C.N 000 164 834
Tel 61 2 9316 4666 Fax 61 2 9316 6423

QQ3T00IC
DRAWING NUMBER

REV C

***Attachment 2***

# ATNF Proposal

# Preliminary Concept

*Attachment 2*

**Proposal to Move Antenna 6 from the 6km Site to the Compact Array**

The following proposal uses heavy earthmoving truck tyres attached to the rail boggies to allow the antenna to be towed by an earthmoving machine such as a bulldozer, grader or a heavy all wheel drive farm tractor etc.

The antenna weighs between 250-280 tonnes and the 8 proposed two metre diameter tyres have a load capacity of approx 40 tonnes each at a speed of 2 km/hr.

A track, 20 metres wide, formed using stabilised and compacted road base will connect a ramp at the six km site and one at the west end of the compact array.

It is recognised that additional work maybe required where the track passes across floodways.

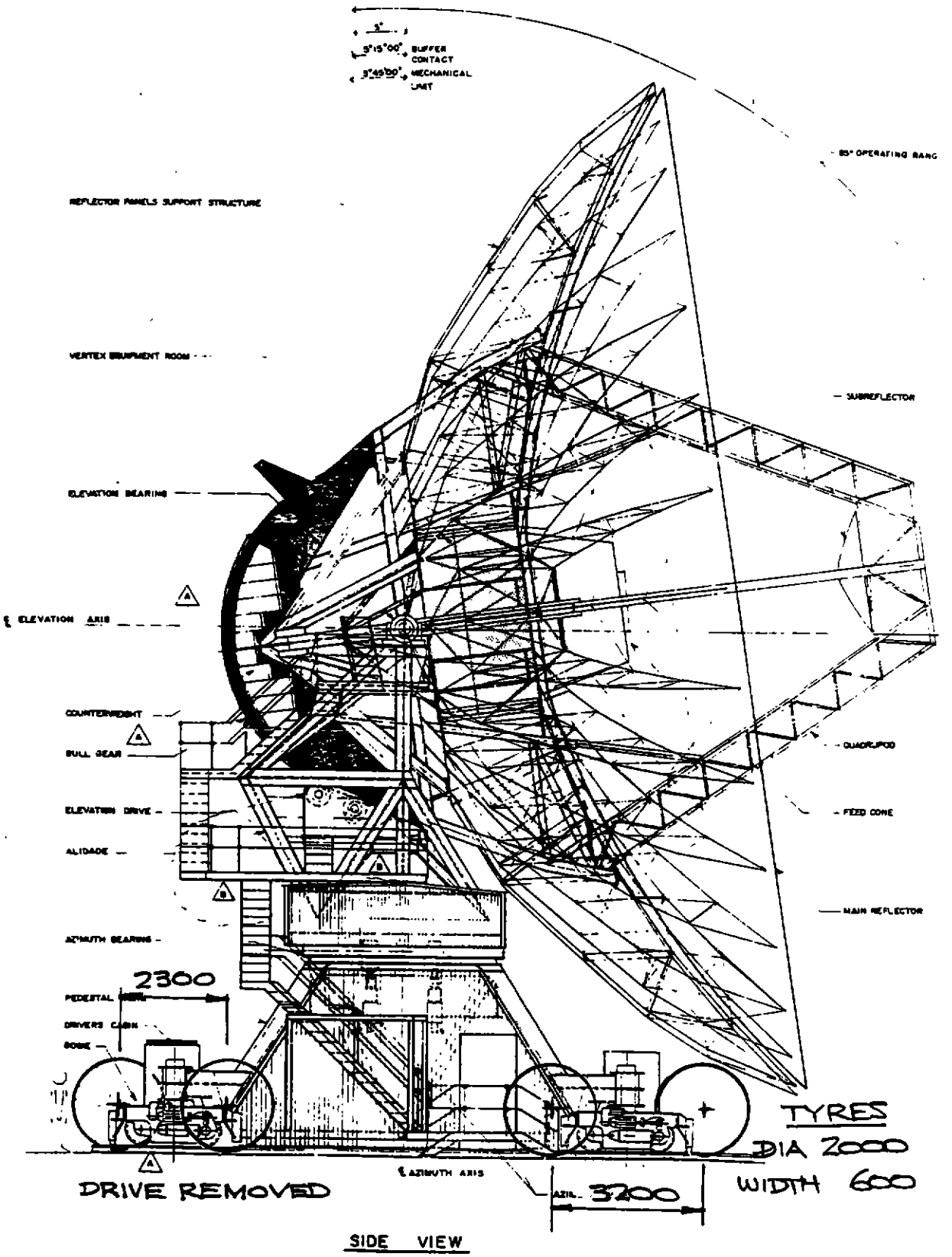
Two wheels will be bolted to each of the four boggies in a way that will not significantly increase the stress on the structure.

The antenna will then be raised off the station posts using its hydraulic system and a winch then used to control its movement down the ramp until it reaches level ground.

A tow vehicle will be used to tow the antenna at a speed of 2 kph until it reaches the bottom of the other ramp. A winch will pull the antenna up the ramp. Guide rails will ensure alignment of the steel wheels with the rail. Once the antenna is located on the compact array rails, the tyred wheels can be removed. There is the possibility that the wheels could be left attached when on station at the 6km site.

As a handwaving estimate of cost say $750,000

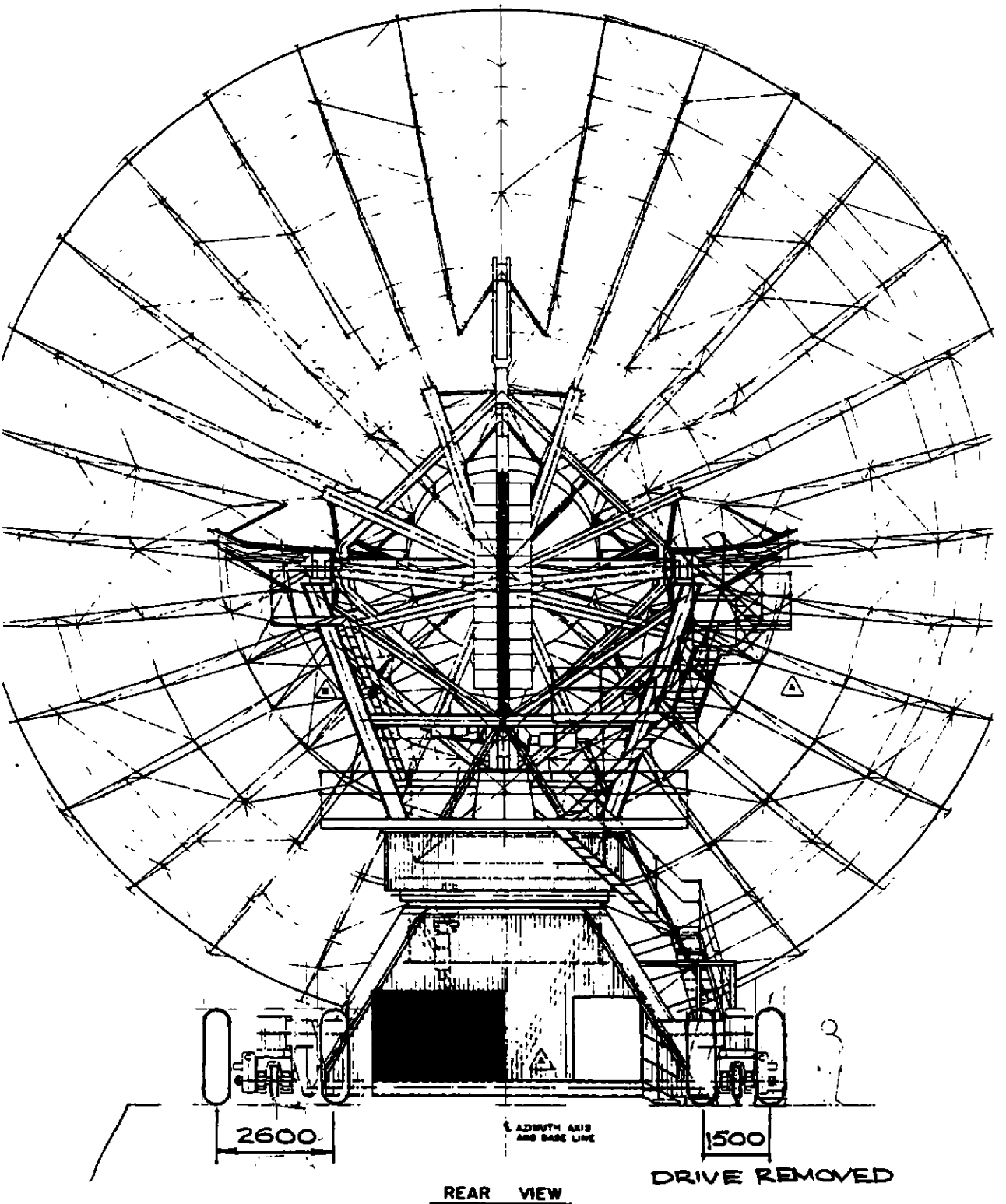
B.F. Parsons
23rd February, 1999
*Ref:BFP/gam:2-99*


5°
5°15'00" BUFFER CONTACT
5°45'00" MECHANICAL LIMIT
85° OPERATING RANG
REFLECTOR PANELS SUPPORT STRUCTURE
VERTEX EQUIPMENT ROOM
SUBREFLECTOR
ELEVATION BEARING
℄ ELEVATION AXIS
COUNTERWEIGHT
BULL GEAR
QUADRUPOD
ELEVATION DRIVE
FEED CONE
ALIDADE
MAIN REFLECTOR
AZIMUTH BEARING
2300
PEDESTAL
DRIVERS CABIN
BOGIE
TYRES
DIA 2000
WIDTH 600
DRIVE REMOVED
℄ AZIMUTH AXIS
AZIL. 3200

SIDE VIEW

22000 DIA

Scale ≈ 1:100




REAR VIEW

COPY

ATTACHMENT 3.

# CSIRO AUSTRALIA
# ATNF – Narrabri Facility

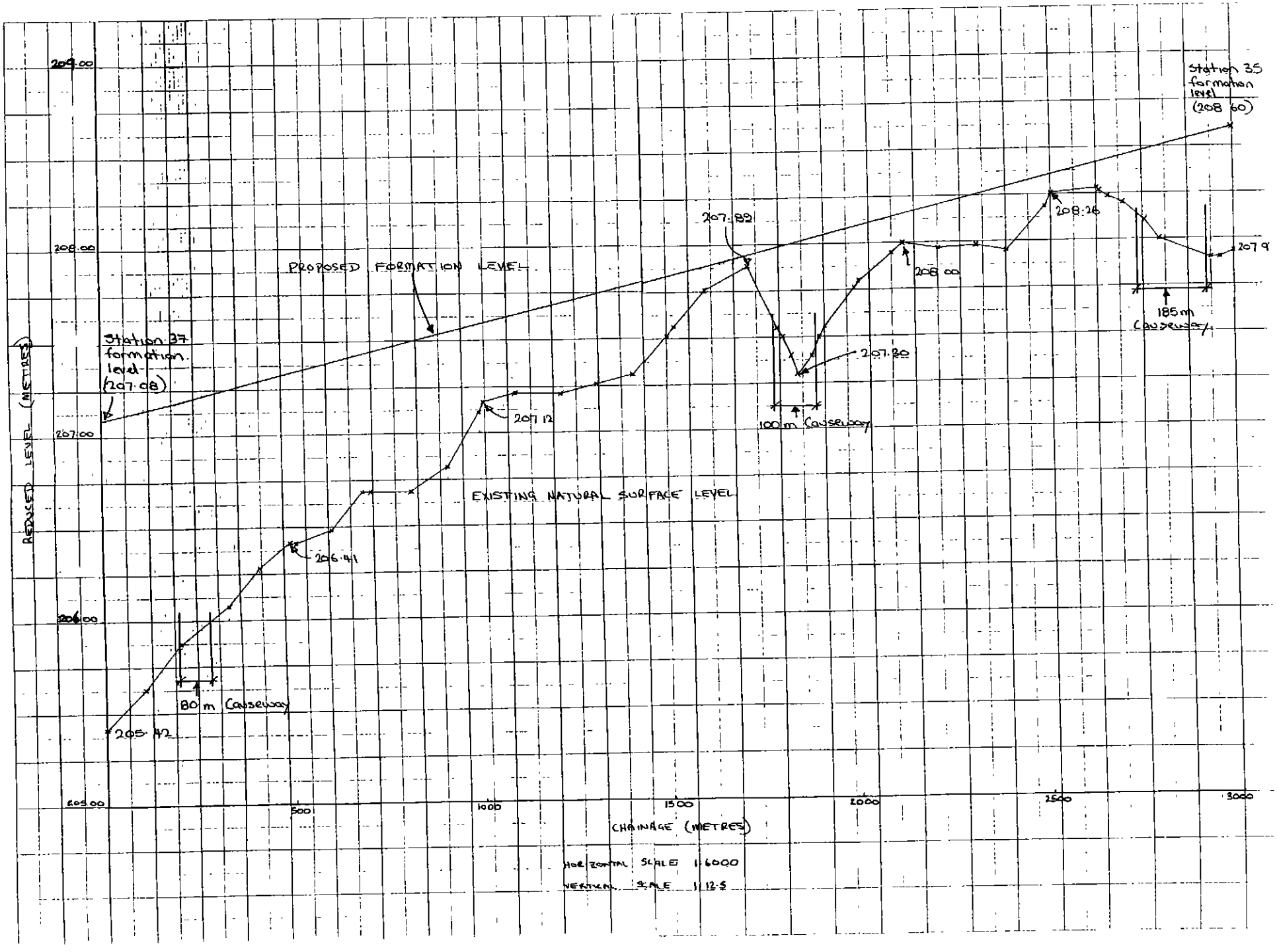
# PROPOSED RAILWAY EXTENSION BETWEEN THE 3 AND 6 KILOMETRE SITES

# SCOPING STUDY

PREPARED BY

BARCLAY MOWLEM CONSTRUCTION LIMITED

January 1999


209.00
208.00
207.00
206.00
205.00
REDUCED LEVEL (METRES)
Station 37 formation level (207.08)
PROPOSED FORMATION LEVEL
Station 35 formation level (208.60)
207.82
208.26
207.9
208.00
185m Causeway
207.80
207.12
100m Causeway
EXISTING NATURAL SURFACE LEVEL
206.41
80m Causeway
205.42
500
1000
1500
2000
2500
3000
CHAINAGE (METRES)
HORIZONTAL SCALE 1:6000
VERTICAL SCALE 1:12.5

# PROVISION OF PROPOSED RAILWAY EXTENSION BETWEEN THE 3 AND 6 KILOMETRE SITES

## SCOPING STUDY

### 1. INTRODUCTION

CSIRO ATNF are investigating the feasibility to provide an extension to their existing railway line at the Narrabri Radio Telescope site between the 3 and 6 kilometre mark.

The Narrabri site is located approximately 20 kilometres west of the township of Narrabri.

At present, a telescope is 'imprisoned' at the so-called 6 kilometre site. At various times throughout the year, the site staff at Narrabri would like to move the antenna at the '6 kilometre site' to include the antenna in certain configurations. An extension to the railway line between the 3 and 6 kilometre marks would provide a means of allowing the '6 kilometre' antenna access to the east.

The options to be examined are discussed in more detail in section 3 of this report.

Barclay Mowlem have been commissioned by CSIRO to prepare a basic scoping study outlining a review of options A1 & A2, preparation of budget estimates for construction costs and corresponding programs, identification and comment on environmental issues associated with the construction and recommendations for any further studies.

# 2. INVESTIGATION

CSIRO are investigating to join their existing railway line between the 3 and 6 kilometre site.

This investigation outlines a basic scoping study outlining technical feasibility and indicative budget cost of the rail infrastructure required for various options.

## 2.1. Current Track Arrangement

The existing track comprises 68 kg rail head hardened, mono prestressed concrete sleepers, Pandrol fastenings and 47 kg tie beams.

## 2.2. Current Site Conditions

The site between the 3 & 6 km site is rural in nature. It is believed the CSIRO have an easement for the existing road between the 3 and 6 km mark. CSIRO would have to negotiate an easement with the current property owner to build the extension.

In terms of the services in the area it appears the following would have to be investigated ;

- Telstra cable on the north side of the proposed track
- Power cables
- CSIRO fibres and multicables

Services are obviously an area for further detailed investigation.

# 3. DESIGN CRITERIA AND OPTIONS

## 3.1 Line Life

The line is proposed to have a low usage with only a few passes of the antenna each year. Hence a 60 kg std carbon rail should be able to be utilised in lieu of the 68 kg head hardened rail on the existing line.

## 3.2 Site Visit

A site visit was held on 10/10/98 between Glenn Bentley and Hew Pengelly to investigate any parameters to be considered for the scoping study.

Photographs were taken of the proposed site and are presented in Appendix 1.

Critical parameters to be considered include the following;

- The proposed line will cross several waterway areas and hence will required several large culverts to be installed.
- Location of services will need to be investigated in detail
- Lease or otherwise for an easement to build the proposed line will need to be negotiated with the current land owner.
- The relative cost of using conventional track materials and quicker construction time needs to be compared to the mono sleeper option with longer construction time.

## 3.3 Interview 9/10/98

An interview was undertaken on 9/10/98 with Graeme Baines by Hew Pengelly. Results of the interview are presented in Appendix 4.

## 3.4 Design Criteria

the primary design consideration is the grade of the proposed railway line between the current two fixed points. The grade of the antenna track is assumed to be level with station 35 being perpendicular to the centre of the earth.

Culvert sizing was assumed only and a more thorough hydrological study will be required. A copy of the assumed culvert sizes is presented in Appendix A 5.

As a result of the low usage of the line it was assumed the following parameters could be used in terms of the railway line and earthworks base ;

- Lighter size rail and std carbon
- Reduced bottom ballast thickness
- Reduced shoulder ballast dimension
- Elimination of lime stabilised layer

## 3.5 Options for Analysis

The two options to be analysed include the following ;

### 3.5.1 Option A1 :Construction of a permanent railway line between the 3 and 6 kilometre sites – using similar track configuration to existing.

*Option A1 would involve construction of a railway line similar to that already in place between the 3 and 6 kilometre mark. The new extension railway line would not have to be constructed exactly the same as the existing east / west line since the usage would be comparatively reduced. This would enable cost savings in permanent materials such as ballast, sleepers and rail.*

*Please refer to Sketch 001 attached for a basic drawing of the layout for Option A1 presented in Appendix 2.*

### 3.5.2 Option A2 : Construction of a permanent railway line between the 3 and 6 kilometre sites – using standard gauge track configuration.

*Option A2 would involve construction of a continuous 'standard gauge' railway line between the 3 and 6 kilometre mark. The new extension railway line would be constructed using 2 standard gauge railway lines. This would enable use of conventional track construction and maintenance plant.*

*Please refer to Sketch 001 attached for a basic drawing of the layout for Option A2 presented in Appendix 2.*

## 3.6 Siding Design

### 3.6.1 Option A1 : Construction of a permanent railway line between the 3 and 6 kilometre sites – using similar track configuration to existing.

This option would involve construction of a railway line between the 3 and 6 kilometre mark. The railway line would not have to be constructed exactly the same as the existing east / west line since the usage would be comparatively reduced. We assume that the line would be used for travel only and that no stations would be required.

We have noted several alternatives that may be available in terms of reducing the cost of construction and use of alternative materials.

#### *3.6.1.1 Earthworks*

We consider that since the track would be for passage of limited numbers of antennas each year that no lime stabilisation layer would be required. I would envisage that the earthworks required would be as follows :

- removal of topsoil
- placement of select fill to subgrade level (eg quarry overburden)
- then placement of 150 to 200 mm thick base of crushed sandstone or crusher dust (5 minus fines)
- then placement of a 100 to 150 mm thick layer of capping.

The crushed sandstone is locally available and relatively cheap.

Geotechnical and hydraulic information may need to be gathered for the 3 to 6 kilometre site area.

#### *3.6.1.2 Drainage*

The route from the 3 to 6 kilometre site crosses several causeways. A series of shallow box culverts or similar would have to be installed under the track.

With the ballast depth under the sleeper kept to a minimum then the formation of the track would be above the normal formation level on the existing east / west track.

Side drains running east / west would have to be provided.

### *3.6.1.3 Track Construction*

- **Ballast**

Ballast depth on the track extension could be reduced when compared to the existing east / west line. A ballast depth of approx 200 to 250 mm should be acceptable (current design is approx 400 mm). It is noted that the track ballast depth varies form 200 to 300 mm.

The ballast shoulder width could also be reduced to about 300 to 400 mm with the use of a concrete mono sleeper similar to that used on the existing line.

This reduction of ballast depth and shoulder width would reduce the volume of ballast significantly when compared to the existing east / west line and hence reduce costs. Careful design of earthworks finished levels should also ensure minimisation of filling.

- **Concrete sleepers**

The scoping study has based this option on using the same prestressed concrete monorail sleeper as used on the east / west line.

- **Rail**

60 kg rail standard carbon has been used in lieu of the 68 kg head hardened rail currently used. We believe that the rail would not have to be head hardened.

The rail would be delivered in 110 metre lengths (pre-welded into long lengths prior to delivery) to Culgoora rail siding and dragged to the site. This would reduce on-site welding costs (eg 60 no. on-site welds for long lengths versus 480 no. on-site welds if rail are in short lengths.).

- **Joints / Fastenings**

Fastenings used would be Pandrol clips. All rail would be fully welded and destressesed as far as practicable.

- **Tie Beams**

Tie beams would still have to be used. Spacing would have to be further investigated but spacing could in all probability be increased.

### 3.6.2 Option A2 :Construction of a permanent railway line between the 3 and 6 kilometre sites – using standard gauge track configuration.

This option would involve construction of a conventional railway line between the 3 and 6 kilometre mark.

#### *3.6.1.2 Earthworks*

As per option A1

#### 3.6.1.3 Drainage

As per option A1

#### 3.6.1.4 Track Construction

- **Ballast**

More ballast would be used for this option when compared to option A1.

- **Concrete sleepers**

- Option adopted was to use a conventional standard gauge concrete sleeper as used on the 'normal ' railway line. Use of a conventional second hand or 'seconds' standard gauge concrete sleeper as used on the 'normal ' railway line was not adopted but still could be utilised if available. The relative cost saving is not great

A conventional concrete sleeper is at least 25 % cheaper to supply than the monorail sleepers. Use of a conventional sleeper does enable standard track construction and maintenance plant to be utilised and hence reduced construction and maintenance cost.

- **Rail**

The same comments apply as per Option A1. This option would also involve double the quantity of rail being constructed with standard gauge materials.

- **Joints / Fastenings**

The same comments apply as per Option A1

- **Tie Beams**

The same comments apply as per Option A1

## 3.7 Environmental Issues

### *3.7.1 Noise*

It is expected that noise from antenna movement will not be a problem. Noise during construction should not be significant because of the remote location of the site.

### *3.7.2 Dust*

Dust during earthworks construction operation should be controlled by utilising a water truck full time on site. Dust from the newly installed rail siding will present no problems.

### *3.7.3 Water Management*

During earthworks construction for the new siding(s) full erosion and sedimentation controls shall be put in place. Sedimentation traps will have to be strategically positioned to avoid contamination of nearby watercourses. Several significant drainage structures will need to be installed. Measures will need to be taken during times of inclement weather.

# 4. CONSTRUCTION COST ESTIMATES

In this scoping study, budget cost estimates have been prepared for construction work to a conceptual level of detail.

Construction costs for each component of the works have been determined from a combination of historic data, current tender pricing, or from first principles.

All materials have been priced as second hand where possible.

Items that could possibly be obtained second hand include :

- second hand rail
- seconds prestressed concrete sleepers

Please note that at times these items are **not** readily available and so would have to be sourced. Due to the low traffic that the proposed extension would incur, the use of these second hand materials would be suitable if available.

Materials that would have to supplied new includes :

- Prestressed concrete sleepers (mono sleeper)
- Pandrol clips
- Pandrol pads

All cost estimates do not include any costs for structures such as additional stations or stairs as it was assumed no stations would be constructed on the extension.

**Option A1 : Construction of a permanent railway line between the 3 and 6 kilometre sites – using similar track configuration to existing.**

*INDICATIVE COST ESTIMATE –January 1999*

| *Description* | *Quantity* | *Unit* | *Amount* |
|---|---|---|---|
| Design & survey | 1 | Item | $35,100 |
| Establishment | 1 | Item | $21,528 |
| Earthworks incl stripping, filling and subbase & base | 3,000 | Route metres | $2,599,896 |
| Culverts – supply and install | 3 | No. | $3,721,530 |
| Level Crossings | 3 | No. | $37,830 |
| Trackwork – supply materials | 3,000 | Track metres | $2,668,081 |
| Trackwork – installation | 3,000 | Track metres | $577,605 |
| | INDICATIVE TOTAL | | $9,661,570 |

**Option A2 :Construction of a permanent railway line between the 3 and 6 kilometre sites – using standard gauge track configuration.**

*INDICATIVE COST ESTIMATE –January 1999*

| *Description* | *Quantity* | *Unit* | *Amount* |
|---|---|---|---|
| Design & survey | 1 | Item | $35,100 |
| Establishment | 1 | Item | $26,416 |
| Earthworks incl stripping, filling and subbase & base | 3,000 | Route metres | $2,599,896 |
| Culverts – supply and install | 3 | No. | $3,721,530 |
| Level Crossings | 3 | No. | $37,830 |
| Trackwork – supply materials | 3,000 | Track metres | 3,823,157 |
| Trackwork – installation | 3,000 | Track metres | $513,971 |
| | INDICATIVE TOTAL | | $10,757,899 |

More detailed cost breakdowns are presented in Appendix 5.

# 5. SUMMARY

## 5.1. Summary

Results of the scoping study are presented below:

| OPTION | RAIL & EARTHWORKS CONSTRUCTION COST | ESTIMATED DURATION OF ON SITE EARTHWORKS & TRACKWORK |
|---|---|---|
| **Option A1: Construction of a permanent railway line between the 3 and 6 kilometre sites – using similar track configuration to existing.** | $9,661,570 | 32 weeks |
| **Option A2: Construction of a permanent railway line between the 3 and 6 kilometre sites – using standard gauge track configuration.** | $10,757,899 | 30 weeks |

Indicative programs for each option is presented in Appendix 3. The programs indicate typical leadtimes for supply of materials and construction for the three main components ie., earthworks, culverts and trackwork.

The following items are not shown on the program :

- CSIRO time to decide on the option to proceed
- Preliminary design of the option selected by CSIRO
- Design approvals
- Tender Process

The programs presented in appendix 3 show typical construction sequence.

## 5.2. Recommendations

After investigating the criteria, proposed layout, costs and program, we have come to the following recommendation:

- Option A1 : Construction of a permanent railway line between the 3 and 6 kilometre sites – using similar track configuration to existing is the recommended option. This option is 11 % cheaper than Option A2 utilising conventional standard gauge materials.

## 5.3. Course of Action

The next step for CSIRO is to undertake is to carry out a Feasibility Study, which would provide the most viable and cost effective proposal and would include the following steps:

- Additional Survey to check the viability of the track and earthworks design.
- Geotechnical Investigation to determine sub-surface condition
- Hydrology Investigation to research sub-surface water flow and its effect on the proposed track design.
- Preliminary Design Review and Approval.
- Finalise Preliminary Design.
- Revise Quantity Take-off from the Finalised Preliminary Design.
- Produce full Program including all pre-construction activities.
- Produce a Cost Plan