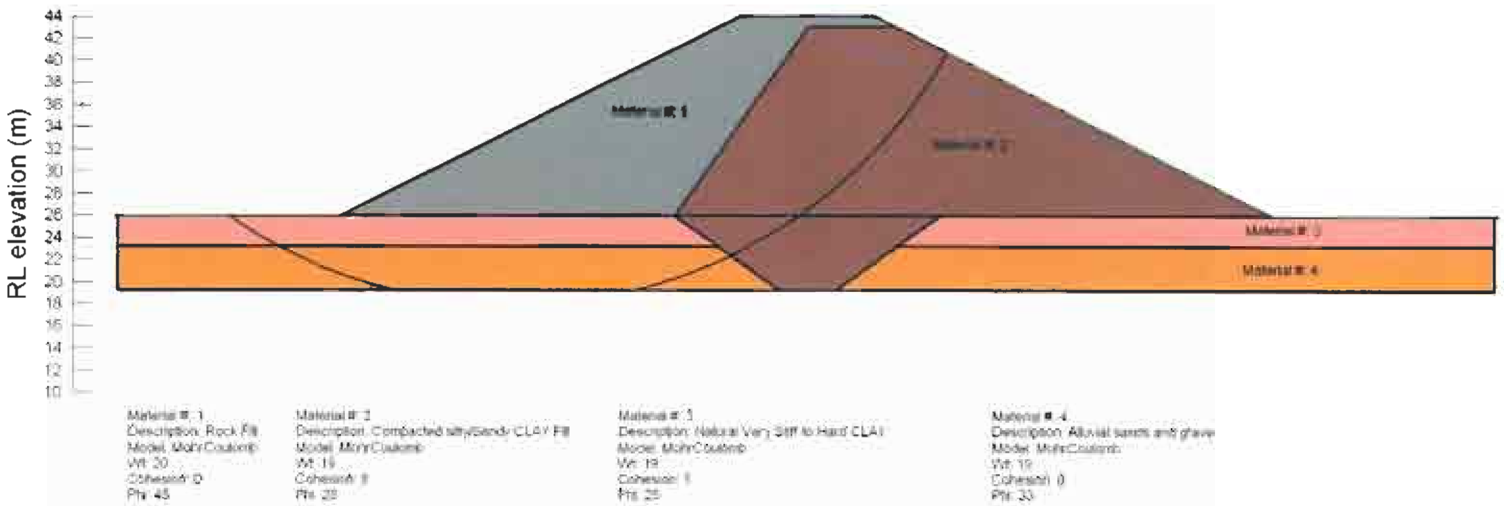
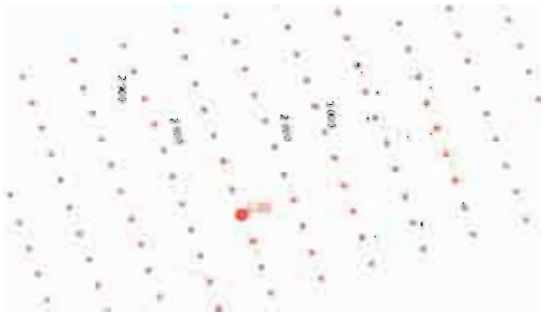
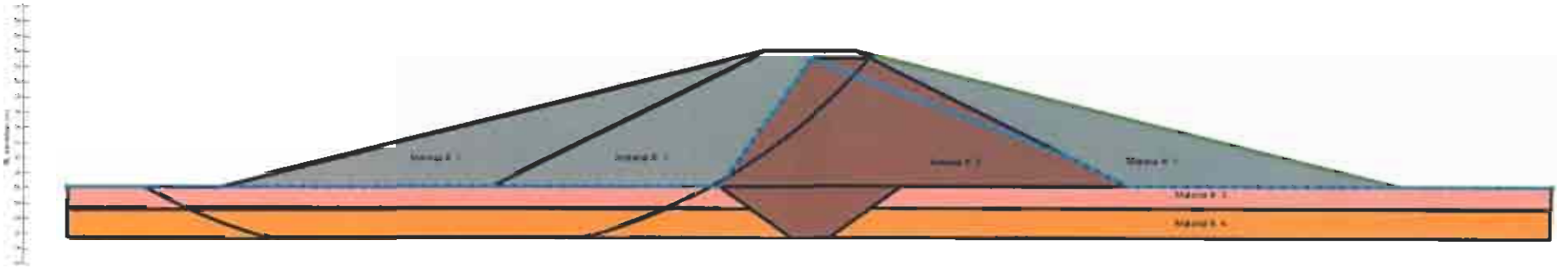


Golder Associates	CLIENT: XSTRATA ZINC		PROJECT: MacArthur River Expansion Project	
	DRAWN: VAL	DATE: 22/05/06	TITLE: **Section 1a : Upstream Stability Rapid Drawdown**	
	CHECKED: GSF	DATE: 5/06		
	SCALE: Not to scale		PROJECT No: 06632038	FIGURE No: 9 / REV No: 1 / A4

J:\Brisbane 06\Geotech 06\06632038_McArthur_River\CORRESPONDENCE_OUT\001-06632038-R-Figures.ppt



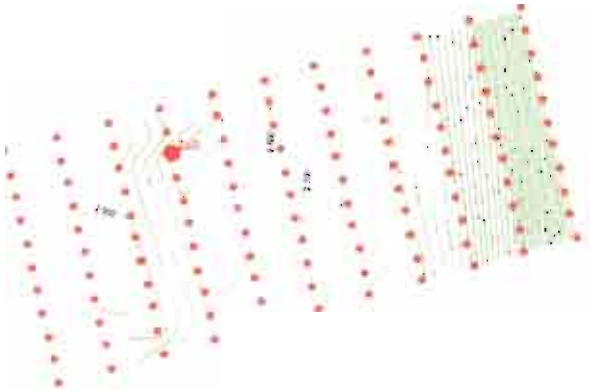


Material #: Material # 1 Description: Rock Fill Model: Mohr/Coulomb Wt: 20 Cohesion: 0 Phi: 40 Piezometric Line: 1	Material # 2 Description: Compacted silt/Sands/ CLAY Fill Model: Mohr/Coulomb Wt: 19 Cohesion: 0 Phi: 28 Piezometric Line: 1
Material # 3 Description: Natural Very Stiff to Hard CLAY Model: Mohr/Coulomb Wt: 18 Cohesion: 5 Phi: 25 Piezometric Line: 1	Material # 4 Description: Alluvial sands and gravel Model: Mohr/Coulomb Wt: 19 Cohesion: 0 Phi: 33 Piezometric Line: Material # 4

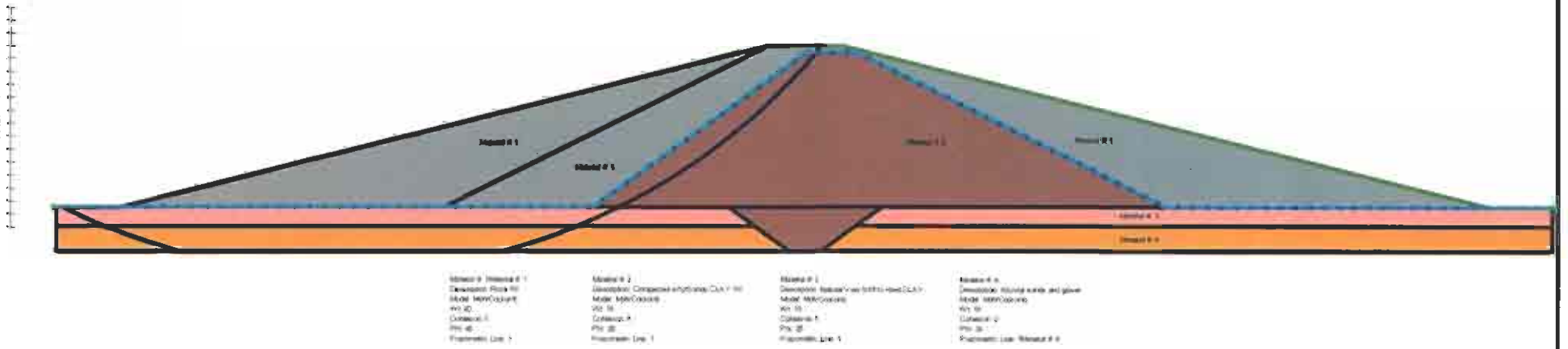
Golder Associates

CLIENT: XSTRATA ZINC		PROJECT: MacArthur River Expansion Project	
DRAWN: VAL	DATE: 22/05/06	TITLE: **Section 1b :Upstream Stability Rapid Drawdown**	
CHECKED:	DATE:		
SCALE: Not to scale		PROJECT No: 06632038	FIGURE No: 10 REV No: 1 A4

T:\Template\Figure_Templates\Powerpoint\GAP A4L.ppt

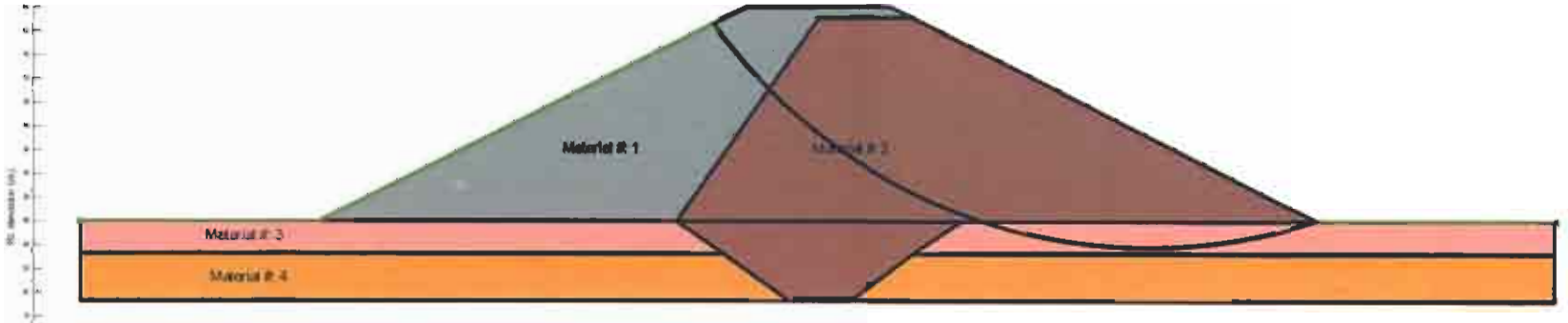


NOTE Creek Crossing Section



Golder Associates	CLIENT: XSTRATA ZINC		PROJECT: MacArthur River Expansion Project
	DRAWN: VAL	DATE: 22/05/06	TITLE: **Section 2b : Upstream Stability Rapid Drawdown**
	CHECKED:	DATE:	
	SCALE: Not to scale	PROJECT No: 06632038	FIGURE No: 11 / REV No: 1 / A4

T:\Template\Figure_Templates\Powerpoint\GAP A4L.ppt



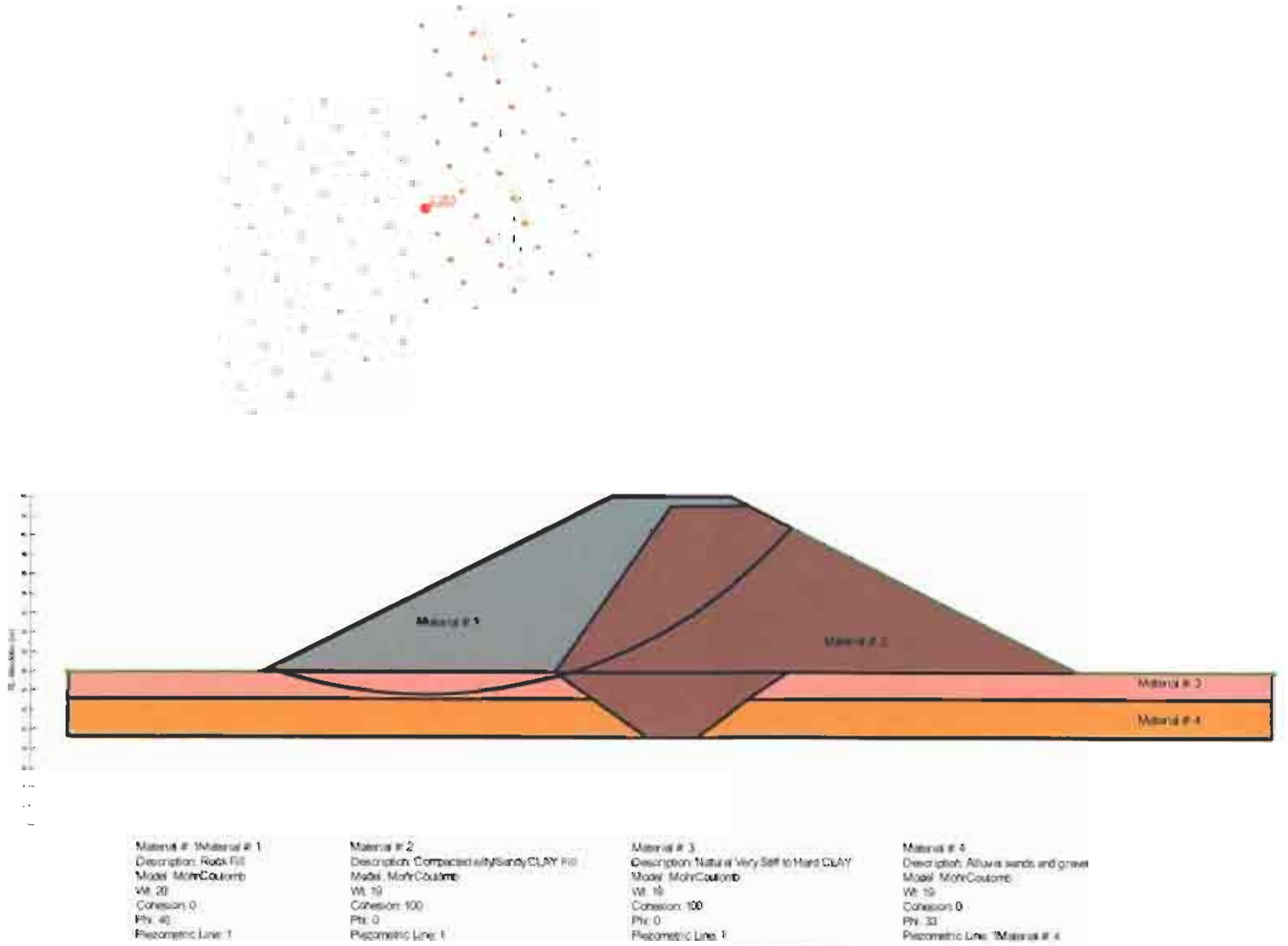
Material # 1
Description: Rock Fill
Model: MohrCoulomb
Wt: 20
Cohesion: 0
Phi: 45
Piezometric Line: 1

Material # 2
Description: Compacted silty/Sandy CLAY Fill
Model: MohrCoulomb
Wt: 19
Cohesion: 100
Phi: 0
Piezometric Line: 1

Material # 3
Description: Natural Very Stiff to Hard CLAY
Model: MohrCoulomb
Wt: 19
Cohesion: 100
Phi: 0
Piezometric Line: 1

Material # 4
Description: Alluvial sands and gravel
Model: MohrCoulomb
Wt: 18
Cohesion: 0
Phi: 33
Piezometric Line: 1

Golder Associates	CLIENT: XSTRATA ZINC		PROJECT: MacArthur River Expansion Project
	DRAWN: VAL	DATE: 22/05/06	TITLE: **Section 1a : Downstream Stability Earthquake**
	CHECKED:	DATE:	
	SCALE: Not to scale	PROJECT No: 06632038	FIGURE No: 12 / REV No: 1 / A4



Material # 1Material # 1
Description: Rock Fill
Model: MohrCoulomb
Wt: 20
Cohesion: 0
Phi: 40
Piezometric Line: 1

Material # 2
Description: Compacted silty/Sandy CLAY Fill
Model: MohrCoulomb
Wt: 19
Cohesion: 100
Phi: 0
Piezometric Line: 1

Material # 3
Description: Natural Very Stiff to Hard CLAY
Model: MohrCoulomb
Wt: 19
Cohesion: 100
Phi: 0
Piezometric Line: 1

Material # 4
Description: Alluvial sands and gravel
Model: MohrCoulomb
Wt: 19
Cohesion: 0
Phi: 33
Piezometric Line: 1Material # 4

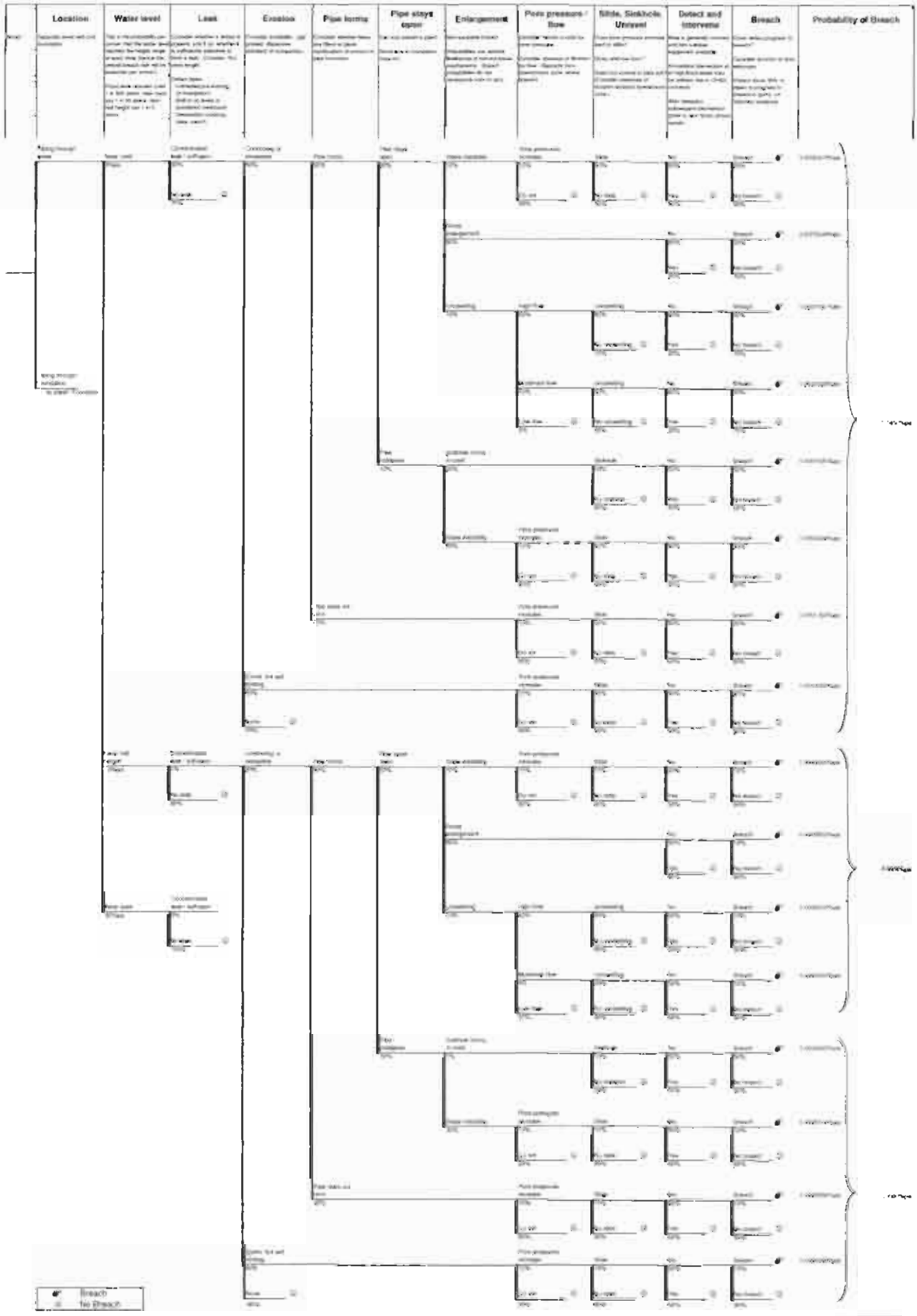
CLIENT: XSTRATA ZINC		PROJECT: MacArthur River Expansion Project	
DRAWN: VAL	DATE: 22/05/06	TITLE: **Section 1a : Upstream Stability Earthquake**	
CHECKED:	DATE:		
SCALE: Not to scale		PROJECT No: 06632038	FIGURE No: 13 REV No: 1 A4

T:\Templates\Figure_Templates\Powerpoint\GAP A4L.ppt

Appendix A
Fault – Event Trees

McArthur River Levee Piping Risk Analysis

Piping Through Levee Without Shells, No Filter

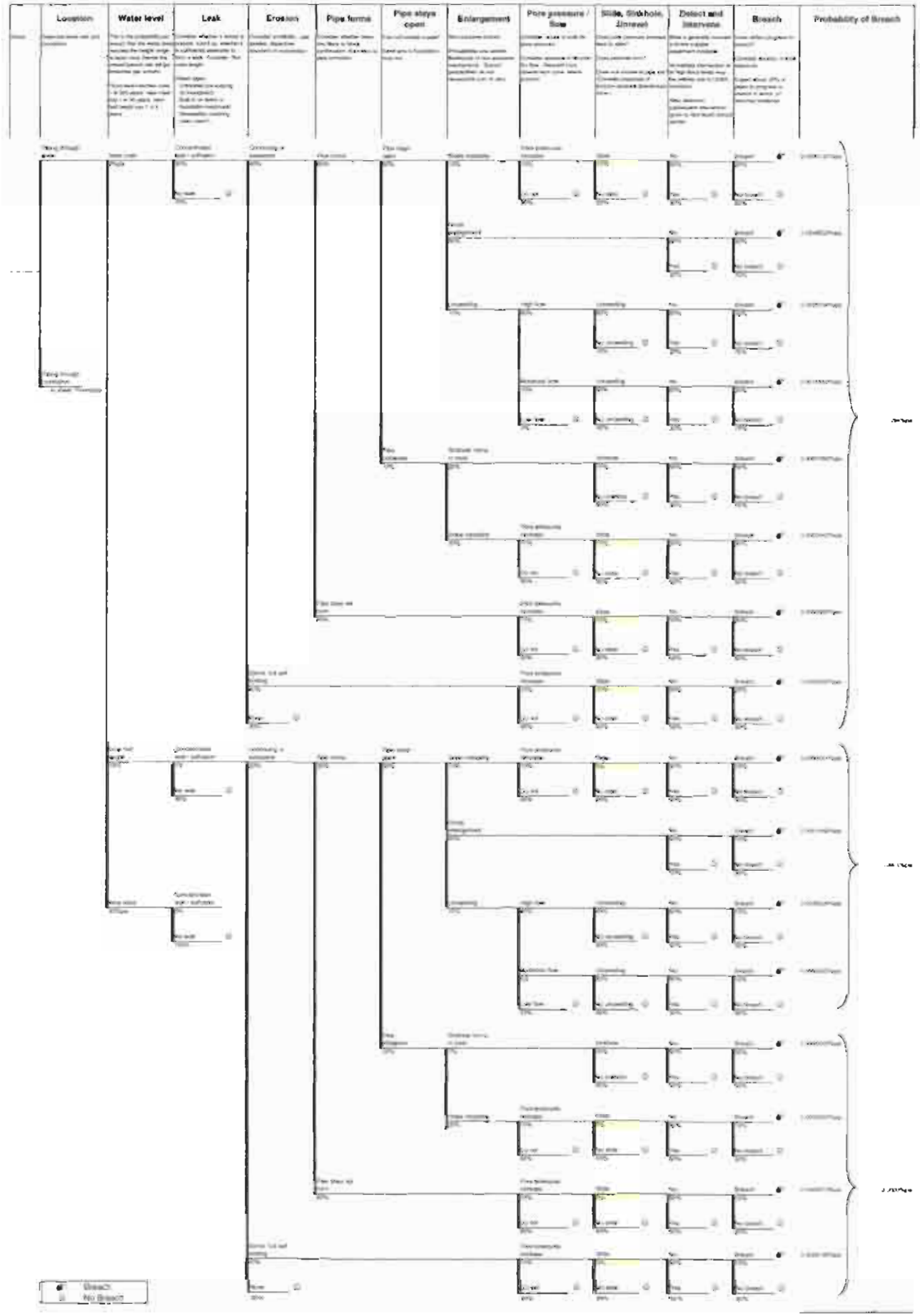


TOTAL 0.045%pa

[~ 1 in 2,200]

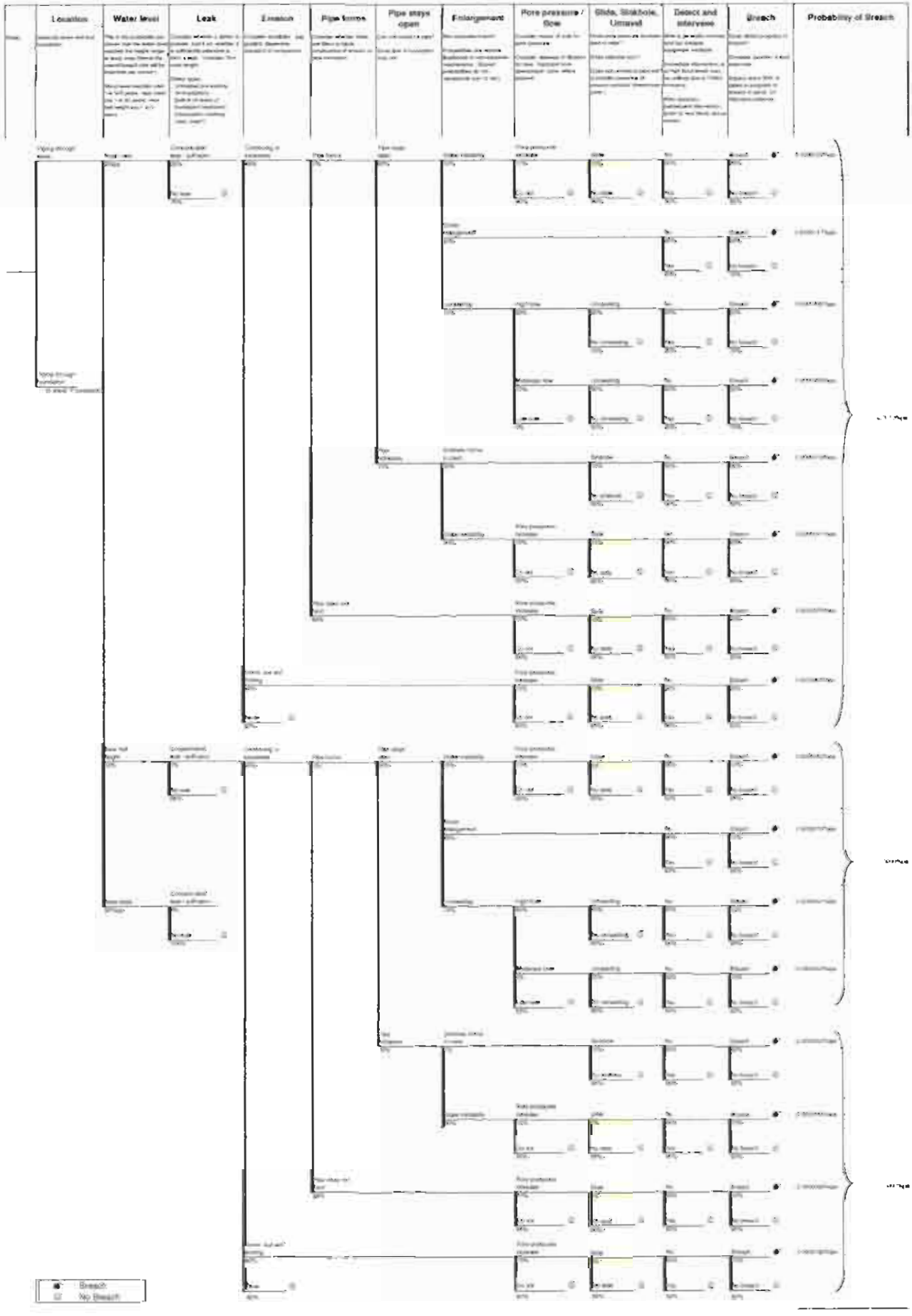
McArthur River Levee Piping Risk Analysis

Piping Through Levee With Shells, No Filter



McArthur River Levee Piping Risk Analysis

Piping Through Levee With Shells and Filter

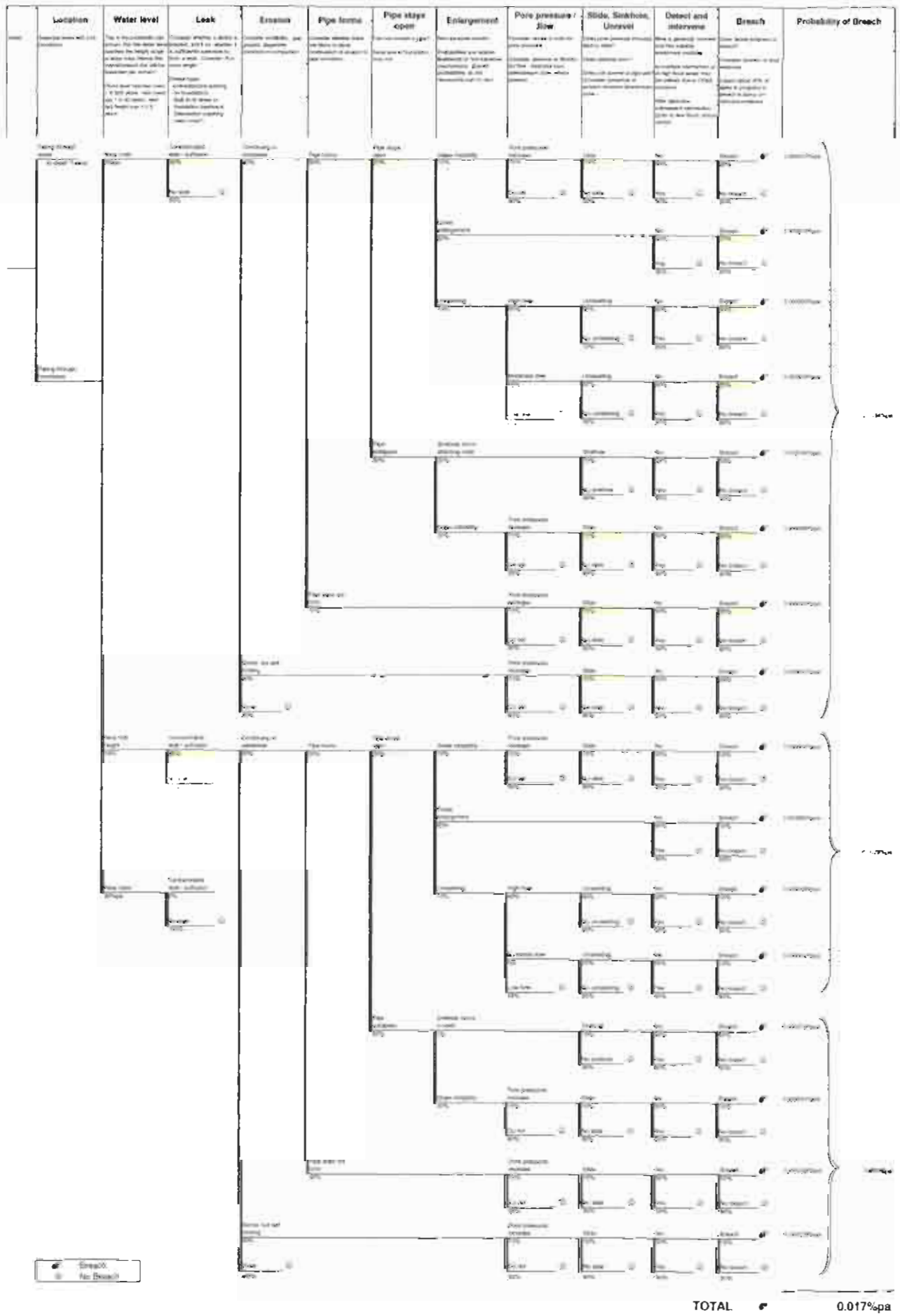


TOTAL 0.001%pa

[~1 in 100,000]

McArthur River Levee Piping Risk Analysis

Piping Through Foundation



Appendix B
Important Information about your Geotechnical Engineering Report

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfil the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. *No one except you* should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you* – should apply the report for any purpose or project except the one originally contemplated.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include : the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, *do not rely on a geotechnical engineering report* that was :

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical change that can erode the reliability of an existing geotechnical engineering report include those that affect :

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *Geotechnical Engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by : the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions *only* at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgement to render an *opinion* about subsurface conditions throughout the site. Actual subsurface conditions may differ – sometimes significantly – from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgement and opinion. Geotechnical engineers can finalise their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognise that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognise that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce such risks, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labelled "limitations", many of these provisions indicate where geotechnical engineers responsibilities begin and end, to help others recognise their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Rely on Your Geotechnical Engineer for Additional Assistance

Membership in ASFE exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE member geotechnical engineer for more information.

ASFE PROFESSIONAL FIRMS PRACTICING IN THE GEOSCIENCES
8811 Colesville Road Suite G106 Silver Spring, MD 20910
Telephone: 301-565-2733 Facsimile: 301-589-2017
email: info@asfe.org www.asfe.org

HGER06983.SM

Appendix B

Technical Specification and Drawings for Civil Works
BEE508-Z-SPEC-001

MCARTHUR RIVER MINE

Technical Specification for Civil Works McArthur River Mine Expansion Project

Prepared for:

XSTRATA ZINC
22 Corunna Street
Albion Qld 4010

Prepared by:

Kellogg Brown & Root Pty Ltd
ABN 91 007 660 317
555 Coronation Drive, Toowong Qld 4066
Telephone (07) 3721 6555, Facsimile (07) 3721 6500

30 June 2006

BEE508-Z-SPEC-001 Rev E

DISTRIBUTION LIST
External
- Connel Hatch
- Xstrata Zinc

Internal
- Project Supervisor
- Master on Contract File

Revision	Date	Comment	Signatures		
			Originated by	Checked by	Authorised by
A	10/11/05	Draft	REV	GJD	REV
B	22/2/06	Initial Review	REV	GJD	REV
C	20/4/06	Final Review	REV	GJD	REV
D	22/6/06	Connell Hatch and URS Changes	REV	GJD	REV
E	30/6/06	Riffle spacing, NAF rock comment, and drawing list amended	REV	GJD	REV

CONTENTS

Section		Page
1	**SCOPE**	
1.1	Background	1-1
1.2	Scope of work	1-1
1.3	Scope of services	1-2
1.4	Works excluded	1-2
1.5	Acceptance of base work	1-2
2	**PRELIMINARIES**	
2.1	Quality assurance	2-1
2.2	Surveillance plan	2-2
2.3	Road closure and traffic control	2-2
2.4	Existing services	2-2
3	**EARTHWORKS—GENERAL**	
3.1	Drainage	3-1
3.2	Unsuitable material	3-1
3.3	Disposal of unsuitable material	3-1
3.4	Backfilling	3-1
3.5	Level 1 supervision	3-1
3.6	Construction water	3-2
3.7	Site access	3-2
3.8	Fencing	3-2
3.9	Control of water during construction	3-2
3.10	Setting out	3-3
4	**STOCKPILE OF MATERIALS**	
4.1	General	4-1
4.2	Stockpile details	4-1
4.3	Drainage of stockpiles	4-1
5	**CLEARING AND GRUBBING**	
5.1	Areas to be cleared and grubbed	5-1
5.2	Removal of trees	5-1
6	**STRIPPING OF TOPSOIL**	
6.1	Areas to be stripped	6-1
6.2	Spread of weeds	6-1
6.3	Mixing and drainage	6-1
7	**EXCAVATION**	
7.1	Operations necessary	7-1
7.2	Material category	7-1
7.3	Foundation stripping and key trench excavation	7-1
7.4	Excavation lines	7-2
7.5	Over-excavation	7-2
7.6	Excavation zones	7-2
7.7	Unit rates	7-2
8	**FILL CONSTRUCTION**	
8.1	General	8-1
8.2	Foundation preparation	8-1
8.3	Impact rolling	8-2
8.4	Placing of fill	8-2
8.5	Fill Materials	8-2
8.6	Zone 1A and 1B material	8-3
8.7	Zone 1C material	8-3
8.8	Zone 1D material	8-3
8.9	Zone 2 material	8-4
8.10	Zone 3 material	8-4
8.11	Compaction and moisture requirements	8-4
9	**PAVEMENT CONSTRUCTION**	
9.1	General	9-1
9.2	Sub grade preparation below pavements	9-1
9.3	Materials	9-1
10	**SEDIMENT AND EROSION CONTROL DURING CONSTRUCTION**	
10.1	General	10-1
10.2	Level spreader	10-1
10.3	Silt fences	10-1
10.4	Maintenance	10-1
11	**GEOFABRIC**	
12	**ROCK SCOUR PROTECTION**	
13	**TOLERANCES**	
13.1	General	13-1
13.2	Embankment / levee	13-1
13.3	Channels / diversion	13-2
13.4	Pavements	13-2
14	**ALIGNMENT AND SURVEY**	
15	**CONCRETE**	

CONTENTS

Section		Page	Section		Page
15.1	General specification for the supply of Readymix concrete	15-1			
15.2	Referenced documents	15-1			
15.3	Quality assurance	15-2			
15.4	Materials for concrete	15-2			
15.5	Concrete mix designs	15-4			
15.6	Classifications of concrete	15-5			
15.7	Production and delivery	15-6			
15.8	Testing	15-8			
15.9	Acceptance and rejection criteria	15-9			
15.10	Steel fibre type and dosage	15-10			
15.11	Batching considerations Fibre reinforced concrete	15-10			
15.12	Soil support system	15-11			
15.13	Aggregates	15-12			
15.14	Curing	15-12			
15.15	Water Stops	15-12			
15.16	Joints	15-13			
15.17	Shrink reducing agent	15-13			
15.18	Sealants	15-13			
15.19	Finishing	15-14			
15.20	Tolerances	15-14			
16	**INITIAL REHABILITATION**				
16.1	General	16-1			
16.2	Fish resting areas	16-1			
16.3	Large wooded debris (LWD)	16-1			
16.4	Timber groynes	16-2			
16.5	Rock fracturing	16-2			
16.6	Top soil spreading	16-3			
16.7	Treatment of dispersive soils	16-3			
APPENDICES					
A	Drawings				
B	Surveillance Plan				

1 Scope

1.1 BACKGROUND

The McArthur River Mining Joint Venture (MRM) is proposing a change in mining method for the existing McArthur River zinc–lead–silver mining and processing operation which is located approximately 45 km south-west of Borroloola and 740 km south-east of Darwin in the Gulf Region of the Northern Territory.

The current operations were established in 1995 and consist of an underground mine and processing plant that converts the mined ore into bulk concentrate. The concentrate is trucked from the mine to the port of Bing Bong where it is loaded into ships for export to refineries around the world to be made into zinc and lead metal and alloys.

The McArthur River Mine Open Cut Project will result in

- extension of life of the mine by 25 years
- change in the mining method
- increase in production of 1.6–1.8 Mt/a

1.2 SCOPE OF WORK

All operations will take place within the existing mining leases.

The Works under the Contract shall include, but not be limited to:

- realignment of the McArthur River and Barney Creek around the proposed open cut mine
- construction of a flood protection bund around the open cut mine and associated infrastructure facilities to prevent floodwaters inundating these operational areas
- preparation of the foundation of the Overburden Emplacement Facility and associated storm water control facilities
- construction of the waste ore haul road from the open cut pit to the Overburden Emplacement Facility (OEF)
- construction of a haul road crossing over the realigned Barney Creek channel
- placement of large wooded debris (LWD) in channels and spreading topsoil over channel rock armouring.

1.3 SCOPE OF SERVICES

The scope of services required under this Contract shall include, but not be limited to:

- preparation and implementation of quality systems
- preparation and implementation of detailed construction schedules
- review and acceptance of survey data provided by others, including location of underground services
- cooperation and coordination with other contractors
- continuously monitor and maintain installed works in accordance with the agreed Safety and Environmental Management plans
- continuously keep the site clean of construction and general debris
- provision of all facilities, cranage, hoisting, scaffolding, shoring, protective screens and hoardings and other temporary works as may be necessary.

1.4 WORKS EXCLUDED

The following non-exhaustive list of items excluded from the scope of this Contract and carried out under other contracts are:

- placement and compaction of Zone 3 materials on the levee
- removal and relocation of services.

1.5 ACCEPTANCE OF BASE WORK

Commencement of any work shall imply that the Contractor unconditionally accepts the previous work (whether conducted by the Contractor or other Contractors) and requires no extra payments or special recompense and such commencement shall render the Contractor liable for all costs incurred by the Principal in making good any resultant defects.

The Contractor shall not proceed to carry out its work over other work if in its opinion the previous work is unsatisfactory or unsuitable, unless the Superintendent issues a written instruction overriding such objection and the Superintendent accepts responsibility for such work proceeding.

2 Preliminaries

2.1 QUALITY ASSURANCE

The Contractor shall control and maintain effective control of the quality of the Works, provide test facilities and perform all examinations and tests necessary to demonstrate conformance of the Works to the requirements of the Contract and shall offer for acceptance only Works that so conform.

The Contractor shall establish and maintain a system of records that provide objective evidence that the requirements of the Contract have been satisfied, and that the Contractor's controls and inspections are effective.

The Contractor agrees to and shall facilitate the Superintendent conducting audits to provide evidence of the use and effectiveness of the Contractor's quality system through the execution of the Work under the Contract. The Contractor shall rectify non-conformances found during audits undertaken by the Superintendent or the Principal.

No part of the quality system shall be used to preclude or otherwise negate the requirement of any part of the Contract, or the obligations of the Contractor pursuant to the Contract.

The Contractor is responsible for ensuring the Works meet all technical and quality requirements of the Contract and shall keep continuous records of action taken and shall advise the Superintendent in writing of significant alterations required to construction or manufacturing techniques to ensure that specified requirements are met.

The Contractor shall ensure that the quality assurance requirements of the Contract are included in any subcontracts entered into by the Contractor.

The Contractor's quality system shall include the following elements:

- quality manual
- quality plan
- quality procedures
- inspection and test plans
- internal audit schedule
- technical procedures and work instructions
- quality records

- reference and other related documents.

The quality system shall be submitted by the Contractor for review and comment by the Superintendent at least 30 days prior to the commencement of the Works.

The Contractor shall also comply with any further quality assurance specification documents or requirements that are incorporated into the Contract by the Superintendent from time to time.

2.2 SURVEILLANCE PLAN

The Contract Surveillance Plan is provided to inform the Contractor of the surveillance activities which will be conducted by the Superintendent in connection with this Contract and of the Contractor's corresponding responsibilities. These activities are set out in Appendix B. The Contractor is required to cooperate with the Contract Surveillance Plan.

The Contractor shall, upon being given reasonable notice by the Superintendent, make or arrange to make available all facilities, documentation, needs and personnel, including those of any subcontractors that are reasonably required for any surveillance activity to be undertaken. The Contractor shall provide at least two working days notice prior to needing a witness and at least two working days prior to the hold point in the Contract Surveillance Plan.

2.3 ROAD CLOSURE AND TRAFFIC CONTROL

Where it may be necessary for roads to be restricted or closed for short periods associated with permanent or temporary construction or erection works, it shall be the Contractor's responsibility to arrange for and coordinate approvals and field assistance of all appropriate authorities having jurisdiction.

A minimum 48 hours notice shall be provided to the Superintendent of any planned road closure. Cancellation of closure shall be advised to the Superintendent at the earliest possible time.

The Contractor shall provide or arrange for the provision of all roadway workers, warnings and deviation signs and the like required by the authorities or the road closure codes and standards listed below and shall pay any fees arising.

Control of traffic and road closures during construction shall be the responsibility of the Contractor. Adequate warning signals, bollards, cones and flagmen shall be provided in accordance with AS 1742.

2.4 EXISTING SERVICES

The existing services shown on the drawings comprising this specification are diagrammatic only and shown in good faith, from existing records.

It shall be the responsibility of the Contractor to check and ascertain the actual position of underground and overhead services including checking with relevant authorities.

The Contractor shall be responsible for any damage to services arising during the performance of Work under the Contract and shall take all necessary precautions during the currency of the Contract to protect all services from damage and people from injury. Any damage to services shall be notified to the Superintendent immediately, together with a plan for repair, for the approval of the Superintendent.

3 Earthworks—general

3.1 DRAINAGE

Notwithstanding anything specified herein or shown on the Drawings the Contractor shall at all times conduct its operations to ensure that the Works are self draining. Adequate provision for temporary drainage shall be made to ensure that ponding or flooding on the site or external to the site does not result from any of the Contractor's operations.

3.2 UNSUITABLE MATERIAL

After completion of topsoil stripping operations should soft, loose or permeable soils, or other materials which in the Superintendent's opinion are unsuitable, be exposed in areas of fill construction, such material shall be removed as directed by the Superintendent. The Contractor shall notify the Superintendent prior to commencement of removal of any unsuitable material from below the filling and the Superintendent shall then direct the extent of removal of the unsuitable material. At this time, the Contractor and the Superintendent shall agree on the method of measurement of the material directed to be removed.

3.3 DISPOSAL OF UNSUITABLE MATERIAL

Unsuitable material from the flood protection bund footprint shall be disposed of at locations nominated by the Superintendent within the flood protection bund. The cost of excavation and disposal of unsuitable materials shall be paid at the unit rate under the relevant item in the Bill of Quantities for the agreed net cut quantity.

3.4 BACKFILLING

Backfilling shall not proceed until the Superintendent is satisfied that sufficient unsuitable material has been removed. Backfilling shall be carried out in accordance with the requirements of this Specification using approved material from excavation zones.

3.5 LEVEL 1 SUPERVISION

The Earthworks component of this Contract involves Level 1 Supervision (AS 3798–1996). The Level 1 Supervision shall be provided independently by the Principal.

3.6 CONSTRUCTION WATER

Water for construction shall be made available from existing dams or standpipes as advised by the Superintendent. The Contractor shall provide all equipment including pumps, standpipes and control valves necessary for the extraction of water from dams if required.

3.7 SITE ACCESS

The Contractor shall construct and maintain his own means of access to the Works at no additional cost to the Principal. Any new access tracks or haul roads that the Contractor wishes to install must receive the prior approval of the Superintendent. If existing roads are available, the Contractor may use these roads, after reaching agreement with the Principal regarding maintenance.

All roads used by the Contractor for construction purposes shall be watered and maintained by the Contractor to the satisfaction of the Superintendent

3.8 FENCING

The Contractor shall ensure that all fences affected by the Works remain fully functional. Where it is necessary to cut or remove a section of fencing to provide access to the works, temporary fencing and/or gates shall be installed. Temporary fencing and/or gates shall be maintained in a closed position, except when in use, to ensure the control of grazing animals. The Contractor shall ensure that all gates are securely closed at the end of each working day.

On completion of the Works, all fences shall be fully reinstated to a condition at least as good as that existing at the commencement of the works. The costs associated with maintaining any fencing shall be included in the Contract Sum.

3.9 CONTROL OF WATER DURING CONSTRUCTION

The Contractor shall remove all water from the site of works and shall keep the areas free of water while excavating, preparing foundations, placing backfill as necessary for construction and where required by the Superintendent for inspection or safety of any part of the Works.

The Contractor shall construct and install all necessary spear points, drains, sumps, pumps and other temporary diversion and protective works and shall supply all materials required whether specified in these documents, shown on the Drawings or determined necessary by the Contractor for the performance of the Contract.

The Contractor shall operate and maintain in good condition all equipment necessary for dewatering and shall be responsible for and shall repair, replace or reconstruct at his own expense, any damage to diversion or protective works, foundations, excavations or any other parts of the works caused by water, floods or failure of any part of the levee wall, diversion or protection works.

Separate payment will not be made for the control of water during construction as required by this Clause. The cost of all labour, equipment and materials required by this Clause shall be included in the relevant Schedule Item associated with that part of the work.

3.10 SETTING OUT

The Superintendent shall only establish base lines and benchmarks, which in the opinion of the Superintendent are necessary for the Contractor's purpose in setting out the work.

The Contractor shall, prior to the commencement of earthworks, establish for each reference peg two offset pegs clear of the earthworks so placed that the baseline reference peg may be re-established during construction. The Contractor shall ensure the offset pegs are not disturbed and are adequately protected at all times.

The Contractor shall set such line and level pegs as are necessary for the proper control of earthworks and pavement construction. The Contractor shall in addition verify the existing surface levels and agree with the Superintendent any variations from the levels shown on the Drawings prior to commencement of any work. The Contractor shall employ on the works a suitably qualified surveyor approved by the Superintendent as capable of exercising control of all survey requirements.

The Superintendent reserves the right to periodically check construction levels and set out during and on completion of construction.

Quantities for payment (to the lines and levels shown on the Drawings) must be verified by an independent registered surveyor and must be approved by the Principal.

4 Stockpile of materials

4.1 GENERAL

Where it is necessary for the Contractor to stockpile material for use in embankments or topsoil, such stockpile shall be in accordance with the requirements set out in this section of the specification. The Contractor shall submit a proposal for stockpiling of materials to the Superintendent for approval at least five calendar days prior to commencement of any work requiring such stockpiling. Stockpiling in treed areas will not be permitted.

4.2 STOCKPILE DETAILS

Unless otherwise authorised by the Superintendent, topsoil shall be stockpiled in a loose, non-compacted state to a maximum height of 2 m. The stockpile area shall be free draining. Deep ripping of the stockpile may be ordered by the Superintendent to rectify any compaction that may have occurred. The Contractor shall water all areas within the topsoil stockpile area to minimise airborne dust, as directed by the Superintendent.

Unless in the Overburden Emplacement Facility, stockpiles shall be located on the inside (mine side) of the levee embankment.

4.3 DRAINAGE OF STOCKPILES

Each stockpile shall be protected from surface water run-off by catch drains and the Contractor shall also provide an adequate drainage system to divert water away from the stockpile area.

5 Clearing and grubbing

5.1 AREAS TO BE CLEARED AND GRUBBED

Clearing and grubbing operations shall be limited to those areas required to construct the Works and other areas specified for access.

Areas to be cleared and grubbed shall include:

- all areas on which permanent works shall be constructed, including diversions, drains and embankments
- an area extending to 5 m outside the limit of earthworks for embankments unless noted otherwise on the Drawings.

The Contractor shall complete the clearing in the designated areas such that all trees, stumps, logs, cobblestones, undergrowth, and all obstructions and rubbish of every description are removed.

The Contractor shall be responsible for additional clearing necessary for his own storage, access and work areas in locations only as approved by the Superintendent on site.

5.2 REMOVAL OF TREES

Beyond the areas to be cleared, only those trees, shrubs and over-hanging branches that directly interfere with the construction of the Works shall be removed or pruned as necessary. Such removal or pruning shall only be carried out after consultation with the Superintendent.

6 Stripping of topsoil

6.1 AREAS TO BE STRIPPED

Topsoil stripping shall include fill areas, embankments, excavations, borrow pits, haul roads, the Contractor's temporary access roads and stockpile areas for materials other than topsoil.

Unless otherwise specified, topsoil shall be stripped from fill areas:

- between the limits of the batters as defined by the line through batter points extended to include any rounding
- by means which do not increase the extent of unstable areas
- and be placed in stockpile or prepared areas that are surrounded by bunds to provide protection from overland flow and loss of topsoil from the stockpile.

6.2 SPREAD OF WEEDS

The Contractor shall treat and manage site topsoil before stripping, and after spreading, to remove and/or minimise the spread of weeds and other pathogens and pest organisms throughout the site. Where top soil stockpiles are maintained beyond the commencement of the following wet season, a weed control program will be implemented to control any weeds that germinate within the stockpile.

6.3 MIXING AND DRAINAGE

Stripped topsoil shall not be mixed with subsoil. Stockpiles shall be maintained in a neat, well shaped state capable of shedding water. Topsoil shall be re-spread as soon as practicable. Stripped surfaces which are to be surveyed for measurement purposes shall be graded to an even self draining surface.

7 Excavation

7.1 OPERATIONS NECESSARY

Excavation shall include, but not be limited to, all operations necessary to:

- excavate earth, rock and any other existing material from the areas designated on the drawings as excavation zones irrespective of sub grade conditions
- load, haul, place and compact excavated material to areas shown on the Drawings as embankment fill area
- any other works necessary to complete the earthworks to the line levels and profiles shown on the Drawings and/or specified in the Contract Documents
- load, haul and remove from site (as required) to a location nominated by the Superintendent.

7.2 MATERIAL CATEGORY

Prior to commencing excavation in any area and during excavation work the Superintendent and the Contractor shall inspect each type of material encountered and agree on the category of the material in accordance with the descriptions specified herein.

7.3 FOUNDATION STRIPPING AND KEY TRENCH EXCAVATION

After topsoil has been stripped from the levee foundations, the Superintendent shall determine the depth of foundation excavation required below the Zone 1 embankment, including the depth of the key trench.

The Superintendent may direct that the excavation be greater than or less than the limits indicated on the Drawings or alternatively may direct the excavation of the key trench to be performed in successive stages until a suitable foundation or surface, as determined by the Superintendent, is reached. Each successive stage shall include sufficient clean up to enable the Superintendent to inspect the foundation in order to direct further excavation, if required, or clean off of foundations for approval.

The key trench shall be excavated to a width such that the minimum base width indicated on the Drawings can be maintained free from contamination or loose material from the sides of the excavation.

No placement of fill within the foundation area shall occur until the Superintendent has inspected and approved the prepared areas.

7.4 EXCAVATION LINES

The Contractor must carry out excavation in a manner which ensures that the integrity of the material beyond the excavation lines is not unduly disturbed. In the event that, in the opinion of the Superintendent, the integrity of the material beyond the excavation zones is disturbed, the Contractor shall at its own cost, make good such material to the satisfaction of the Superintendent.

7.5 OVER-EXCAVATION

In the event of unauthorised over-excavation of material below the required levels, the cost of such over-excavation and backfilling with compacted material as specified herein shall be borne entirely by the Contractor.

7.6 EXCAVATION ZONES

Excavation zones shall be so worked as to allow for the orderly and efficient removal of material for later incorporation into the different layers within fill zones.

7.7 UNIT RATES

The unit rates for net cut in the Bill of Quantities and the Lump Sum of the Contract generally shall be deemed to include excavation, loading, hauling, mixing/blending if necessary, placing and compaction of excavated material (including construction of haul roads) to embankments.

8 Fill construction

8.1 GENERAL

Fill construction includes the preparation of areas upon which fills are to be constructed and the selection, placement, and compaction of fill.

8.2 FOUNDATION PREPARATION

Following stripping of the embankment foundations to the lines and levels shown on the Drawings, the excavated surfaces shall be immediately inspected by the Superintendent.

Once approved by the Superintendent, the exposed surface of excavation in soil shall be tyned, watered and rolled with a minimum of six passes of a vibrating pad foot roller (minimum 5 t static weight) or Caterpillar 825 (or larger) compactor to the satisfaction of the Superintendent. Where deemed necessary by the Superintendent the compacted sub grade shall be proof rolled with a minimum 5 t static weight smooth drum or pad foot vibrating roller to identify soft spots. Soft spots shall be excavated and replaced with fill compacted in accordance with the specification. Materials excavated from soft spots shall be deemed to be unsuitable and shall be disposed of in a manner acceptable to the Superintendent.

In areas of cracked expansive soil, located in the area of the proposed Zone 1 foundations, the Superintendent may direct the removal, moisture conditioning and re-compaction of materials within 500 mm of the stripped surface. Re-compaction of these materials may be best achieved by moisture conditioning and removal in successive layers followed by placement and compaction in adjoining foundation areas.

Where fill is to be placed over existing embankments, natural or excavated slopes (other than the cut-off trench), and the fill must be keyed into the sloping face. This may be achieved by benching the face as the fill level is raised. Steps between benches shall not be greater than 500 mm. At any time, the combined width of the bench and new fill should not be less than 3 m, to ensure effective operation of the compaction equipment.

Following inspection of the foundations by the Superintendent and immediately prior to placement of the fill, the exposed surface shall be lightly scarified and watered (but free of water in depressions) to achieve an adequate bond with the fill.

Fill placement shall be undertaken as soon as practical after excavation so as to avoid desiccation cracking of the sub grade. The Contractor shall not commence placing any fill on the prepared sub grade until the Superintendent has inspected these areas and has given consent to proceed.

8.3 IMPACT ROLLING

Impact rolling may be carried out below the footprint of the levee in lieu of removal, moisture conditioning and re-compaction of the upper 500 mm thick layer of desiccated natural clay. Impact rolling shall not be used for compaction of general fill or other materials to be used within the levee embankment.

The impact roller shall have potential impact energy of not less than 25 kJ. The nominated areas shall be compacted with a minimum total potential energy input* of 240 kJ/m^2 until the average induced incremental settlement is less than 10 mm for five coverages. In addition, a minimum allowable bearing capacity of 200 kPa is required at the ground surface below the levee.

Any soft areas or areas that do not improve after impact rolling shall be notified to the Superintendent. The Contractor shall submit details of a proposed course of action to rectify such areas to the satisfaction of the Superintendent.

The impact rolling shall be carried out in such a manner as to provide uniform coverage of the total area to be compacted. Prior to commencement of work, the Contractor shall submit details of the proposed impact rolling plan including details of the equipment that will be used, initial site preparation, the pattern of rolling, and the proposed inspection, testing, and monitoring procedures.

* *Potential energy input is defined as the cumulative number of impact blows multiplied by the potential energy impact per blow divided by the total site area.*

8.4 PLACING OF FILL

Fill shall be placed and spread in uniform layers and shall be compacted to meet the specified requirements. The Contractor shall ensure that an adequate bond will develop between each layer of fill. During the placement of fill the surface of each layer shall be kept generally parallel to the surface of the sub grade.

The layer thickness prior to compaction shall be such that the specified compaction is achieved to the full depth of the layer with the equipment and methods proposed by the Contractor. At the commencement of the Works the Contractor shall demonstrate to the satisfaction of the Superintendent that adequate compaction is achieved throughout the layer using the methods proposed.

Prior to the cessation of work each day, the top of the fill shall be shaped and compacted to minimise damage resulting from wet weather.

8.5 FILL MATERIALS

Fill material placed in the embankments shall comprise material excavated from excavation zones as specified herein or on the Drawings. Fill material shall comprise earth, weathered or decomposed rock or shattered rock and shall be free of organic

matter and other deleterious material. More specifically, the material to be used in the fill zones indicated on the Drawings shall be as follows:

8.6 ZONE 1A AND 1B MATERIAL

Zone 1A and 1B material shall comprise low permeability clayey soils including silty clay, sandy clay, gravely clay or clayey sand that complies with the requirements of this Specification and is free of unsuitable material. Material classified as silt, either before or after compaction is not acceptable as Zone1A or 1B fill unless otherwise approved by the Superintendent.

Zone 1A and 1B materials shall comply with the properties shown in Table 8.1

Table 8.1 Zone 1A and 1B material properties

Property	Standard	Value
% passing 37.5 mm	AS 1289.3.6.1	100
% passing 0.075 mm	AS 1289.3.6.1	> 35
Plasticity Index (PI)	AS 1289.3.3.1	20 – 50
Emerson Crumb Number	AS 1289.3.8.1	>2

8.7 ZONE 1C MATERIAL

Zone 1C material shall comprise mixed clayey soils, sandy soils and / or weathered rock that does not comply with the material requirements of Zone 1A or 1B material. Zone 1C material shall comply with the material requirements shown in Table 8.2 and shall be free of unsuitable material. Material classified as silt, either before or after compaction is not acceptable as Zone1C unless otherwise approved by the Superintendent.

Table 8.2 Zone 1C material properties

Property	Standard	Value
% passing 150 mm	AS 1289.3.6.1	100
Plasticity Index (PI)	AS 1289.3.3.1	5 – 50
Emerson Crumb Number	AS 1289.3.8.1	> 1

8.8 ZONE 1D MATERIAL

Zone 1D material shall comprise free draining sandy spoil excavated from the diversions. Zone 1D material shall comply with the material requirements shown in Table 8.3 and shall be free of unsuitable material.

Table 8.3 Zone 1D material properties

Property	Standard	Value
% passing 100 mm	AS 1289.3.6.1	100
% passing 0.075 mm	AS 1289.3.6.1	< 10
Plasticity Index (PI)	AS 1289.3.3.1	Non Plastic

8.9 ZONE 2 MATERIAL

Zone 2 material shall comprise rock fill consisting of excavated weathered or fresh rock that complies with the requirements of this Specification and is free of unsuitable material. Rock fill that consists of weathered finer material shall be placed within the inside part of Zone 2 (i.e. against Zone 1A). Rock fill that consists of fresh larger material shall be placed within the outside part of Zone 2.

Zone 2 material shall comply with the properties shown in Table 8.4 after compaction:

Table 8.4 Zone 2 material properties

Property	Standard	Value
% passing 37.5 mm	AS 1289.3.6.1	< 30
Maximum particle size shall be ½ layer thickness refer Table 9.3		

8.10 ZONE 3 MATERIAL

Not part of this Contract.

8.11 COMPACTION AND MOISTURE REQUIREMENTS

8.11.1 Zone 1A and 1B material

Zone 1A and 1B material shall be placed in uniform near-horizontal layers and each layer shall have a compacted thickness of not more than 200 mm. The material shall be placed as near as possible to Optimum Moisture Content (OMC) with a Moisture Ratio in the range of 0.9 to 1.1.

The material shall be compacted to a dry density ratio of not less than 97% of Standard Maximum Dry Density (SMDD), when tested in accordance with AS 1289.5.1.1, using appropriate equipment determined by compaction trials or as approved by the Superintendent.

8.11.2 Zone 1C

Zone 1C material shall be placed in uniform near-horizontal layers and each layer shall have a compacted thickness of not more than 300 mm. The material shall be placed as near as possible to Optimum Moisture Content (OMC) with a Moisture Ratio in the range of 0.75 to 1.1.

The material shall be compacted to a dry density ratio of not less than 95% of Standard Maximum Dry Density (SMDD), when tested in accordance with AS 1289.5.1.1, using appropriate equipment determined by compaction trials or as approved by the Superintendent.

8.11.3 Zone 1D

Zone 1D material shall be placed in uniform near-horizontal layers and compaction shall be by track rolling.

8.11.4 Zone 2 material

Zone 2 material shall be placed in uniform near-horizontal layers having a maximum loose layer thickness determined in accordance with the following table. The maximum particle size shall not exceed two-thirds of the loose layer thickness.

Table8.5 Zone 2—Maximum loose layer thickness

Static module weight*, Vibrating drum	Maximum loose layer thickness (mm)	
	Voids not filled	Voids filled
5 t	400	300
10 t	600	450
15 t	750	600
20 t	900	750

** Static module weight applies to a single drum of a drawn or self-propelled roller.*

Zone 2 material shall be rolled until mechanical interlock is achieved between particles and until no further depression of the surface being compacted occurs. The number of roller passes for a particular size of roller shall be determined by compaction trials conducted prior to the commencement of fill placement, to the satisfaction of the Superintendent.

9 Pavement construction

9.1 GENERAL

Pavement courses, each consisting of one or more layers, shall after compaction be finished to smooth and uniform surfaces conforming to the limits for level, line, grade, thickness and cross section shown on the drawings or as specified in this Specification.

9.2 SUB GRADE PREPARATION BELOW PAVEMENTS

Once approved by the Superintendent, the exposed surface of excavation in soil shall be tyned, watered and rolled with a minimum of six passes of a vibrating pad foot roller (minimum 5 t static weight) or Caterpillar 825 (or larger) compactor to the satisfaction of the Superintendent. Where deemed necessary by the Superintendent the compacted sub grade shall be proof rolled with a minimum 5 t static weight smooth drum or pad foot vibrating roller to identify soft spots.

Prior to construction of the first pavement layer, the sub grade shall be trimmed and then rolled with a smooth-drum roller so that the surface of the sub grade is a reflection of the final pavement surface to the satisfaction of the Superintendent.

Where deemed necessary by the Superintendent, soft spots shall be excavated and replaced with fill compacted in accordance with the specification. Materials excavated from soft spots shall be deemed to be unsuitable and shall be disposed of in a manner acceptable to the Superintendent.

The prepared sub grade shall be protected from inclement weather that may cause ponding of water. Any soft area caused by ponding shall be removed.

9.3 MATERIALS

Crushed rock aggregates for pavement base and sub-base layers shall consist of clean, hard, durable, angular rock fragments and quarry fines of uniform quality. Crushed rock shall be free from vegetable matter and lumps or balls of clay, and shall comply with the requirements shown in Table 9.1.

Table 9.1 Crushed rock requirements

Property	Standard	Base	Sub-base
Liquid Limit (%)	AS 1289.3.6.1	< 30	< 35
Plasticity Index (%)	AS 1289.3.6.1	2 – 6	2 – 10
PI x % passing 0.425 mm	AS 1289.3.3.1	< 150	< 200
Los Angeles Abrasion	AS 1141.23	> 26	> 22

Property	Standard	Base	Sub-base
CBR (%)	AS 1289.3.8.1	> 80	> 50

The grading envelopes shown in Table 10.2 shall apply to base and sub-base crushed rock aggregates.

Table 9.2 Grading envelopes for base and sub-base crushed rock aggregates

AS Sieve size (mm)	% Passing by mass	
	Base	Sub-base
26.5	100	100
19.0	90 – 100	90 – 100
13.2	75 – 90	70 – 95
9.5	65 – 85	60 – 90
4.75	45 – 65	40 – 70
2.36	30 – 50	30 – 60
0.425	12 – 20	10 – 30
0.075	5 – 10	6 – 15

Compaction and moisture requirements

The dry density ratio and moisture ratio shall be based on laboratory values determined using Standard compactive effort (AS 1289, 5.1.1) for sub grade materials and using Modified compactive effort (AS 1289, 5.2.1) for granular pavement layers.

The minimum degree of compaction and required moisture ratio for each pavement layer shall be as shown in Table 9.3.

Table 9.3 Minimum compaction and moisture ratio for pavement layers

Pavement layer	Dry density ratio (%)	Moisture ratio (%)
Base	not less than 98.0 (MOD)	0.7 – 1.0
Sub-base	not less than 95.0 (MOD)	0.7 – 1.0
Top 300 mm of Sub grade	not less than 100.0 (STD)	0.8 – 1.1

10 Sediment and erosion control during construction

10.1 GENERAL

The Contractor is responsible for the design, implementation and maintenance of sediment and erosion control devices during construction. Unless the device is a permanent structure, it shall be removed when the areas above it have been stabilised.

The sediment and erosion control devices shall be constructed in the locations shown on the Drawings unless an alternative location is directed by the Superintendent.

10.2 LEVEL SPREADER

Level spreaders shall be used as outlets for diversion channels or at other areas of concentrated flow of runoff where conversions to sheet flow onto stable areas is required. The level spreader shall be excavated at zero grade, the length shall be as shown on the Drawings or otherwise specified. The approach grade of the diversion channel shall not exceed 1% for at least 6 m before it enters the spreader. The Contractor shall pay particular attention to the sill to ensure that it remains stable and a vigorous vegetative cover is maintained below it. The channel behind the sill shall be de-silted when directed by the Superintendent.

10.3 SILT FENCES

Silt fences are to be located where run-off has the potential to carry silt from the site. Several rows of silt fences may required at any one location. Silt fences are to be constructed strictly in accordance with Construction Drawing details.

10.4 MAINTENANCE

All sediment and erosion control devices shall be maintained in a satisfactory working order throughout the construction period or until such earlier time as the area above has been stabilised and the Superintendent directs that the device can be removed.

It is the Contractor's responsibility to inspect the devices after each significant rain event for structural damage or clogging by silt and other debris, and to make prompt repairs or replacement where required.

When directed by the Superintendent, the Contractor shall make repairs or replacement to sediment control devices within 24 hours. In severe weather, the repairs are to be made immediately.

All sediment deposited within ponded areas shall be periodically removed to a disposal area as directed by the Superintendent.

Gravel or other filter materials shall be cleaned and restacked or replaced when directed by the Superintendent to maintain effective performance.

All maintenance costs associated with these works shall be deemed to be included in the Lump Sum of the Contract generally.

11 Geofabric

The Contractor shall supply and place geofabric on those surfaces to be protected by rock protection as shown on the Drawings. The geofabric, as specified on the Drawings, shall be a non-woven needle punched continuous filament polyester or polypropylene (ultra-violet light stabilised) having a minimum mass of 270 gm/m^2 and an Austroads G Rating in excess of 3500.

Prior to construction, the fabric shall be stored under cover to protect it from the effects of ultra-violet light from the sun and/or damage by other means.

Cutting of geofabric shall be kept to a minimum and wherever possible joins shall be avoided. Laps between separate sheets of geofabric shall conform to the manufacturers' recommendations as approved by the Superintendent.

The geofabric shall be covered as soon as possible after being placed on the surface to be protected, in order to minimise exposure to ultra-violet light.

12 Rock scour protection

Dumped rock to be used as scour protection shall be hard, dense and durable. The rock shall be placed such that positive interlocking is achieved between individual rocks, producing a compact and tight layer. Where dumped rock is used as scour protection it shall be underlain by geotextile in accordance with the specification and Drawings.

Care shall be used in placing the rock to avoid damage to the underlying geofabric. Rock protection shall be graded as shown on the Drawings.

Table 12.1 Scour protection typical gradings

Item	D_{450}	D_{600}
Maximum Particle Size	700 mm	900 mm
No more than 60 % passing	450 mm	600 mm
No more than 10 % passing	200 mm	250 mm
Crushing Strength	Greater than 25 Mpa	
Length	Greater than 2.5 x width	
Shape	Angular – no diffused cleavage planes	
Layer thickness	Greater than 2 x D_{50}	

"Dumped rock for scour protection" should be differentiated from "rock armouring" required to provide an environment where seeds can germinate and riparian vegetation can become established. Where shown on the Drawings, "rock armouring" is to be spread on excavation batters in alluvium without underlying geotextile. The rock armouring shall be slightly weathered to fresh, reasonably well graded "run of excavation rock" with a maximum block size of 600mm and no more than 60% passing 250 mm. Specification requirements relating to crushing strength, length and shape shall not apply to rock armouring. All rock armouring and scour protection shall be selected from NON ACID FORMING (NAF) types available on site.

13 Tolerances

13.1 GENERAL

The intent of this section of the specification is to establish tolerances that are consistent with modern construction practice and take into account the effect that deviations will have upon the structural action or operational function of the structures. Deviations from the established lines, grades and dimensions will be permitted within the limits described in this clause, except that the Superintendent reserves the right to modify the tolerances described in this clause if such tolerances impair the structural action or operational function of the structure.

Where tolerances are not described in this section of the specification and are not covered by the relevant Australian Standard, permissible deviations will be determined by the Superintendent such that they are compatible with tolerances of similar structures. Specific tolerances shown on the Drawings shall be considered as supplementary to and overriding the tolerances described in this section.

The Contractor shall be responsible for setting out and constructing each section of the work within the prescribed tolerance limits. Any work in which the prescribed tolerance limits are exceeded shall be remedied or removed and replaced by the Contractor at his own expense. The tolerances, unless otherwise stated, shall be measured normal to the centreline or axis and in a horizontal plane.

13.2 EMBANKMENT / LEVEE

Plan position of crest centreline shall not vary by more than 1000 mm from that shown on the Drawings.

No zone shall be constructed to a width, at any level in the embankment, less than that shown on the Drawings.

No point on the completed external batters or on the slope of any zone boundary shall vary from the specified line by more than +600 mm to –600 mm when measured at right angles to the slope. At any cross section the batter slope shall not be steeper than the specified slope.

No point on the completed internal batters shall vary from the specified line by more than +300 mm to –300 mm when measured at right angles to the slope. At any cross section the batter slope shall not be steeper than the specified slope.

No point on the slope of any zone boundary shall vary from the specified line by more than +1000 mm to –1000 mm when measured at right angles to the slope. At any cross section the batter slope shall not be steeper than the specified slope.

The Reduced Level of the crest shall not vary from that shown on Drawings by more than –0 mm to +200 mm.

13.3 CHANNELS / DIVERSION

Plan position of centreline shall not vary by more than 1000 mm from that shown on the Drawings.

The width at any level of the excavation shall not be less than that shown on the Drawings.

No point on the batter slopes of excavation shall vary from those shown on the Drawings by more than +0 mm to –600 mm in rock or +0 mm to –200 mm in soil when measured at right angles to the slope line, where plus (+) is towards the centreline and minus (–) is away from the centreline.

The invert level of channels shall not vary from that shown on the Drawings by more than +0 mm to –250 mm.

13.4 PAVEMENTS

The top of each pavement course shall not differ from the specified level by more than –0 mm to +25 mm.

Each pavement course at any point shall be not less than the specified thickness by more than 10 mm. The combined thickness of sub-base and base courses at any point shall be not less than the specified thickness by more than 15 mm.

No point on the surface of each layer of base or sub-base shall lie more than 10 mm below a 3 m straightedge laid parallel to the centreline of the pavement or below a template placed at right angles to the centreline.

The width of the pavement shall not be less than that shown on the Drawings.

14 Alignment and Survey

The set-out grid used in this Contract shall be project based with levels relating to Australian Height Datum (AHD). Chainages shown on the Drawings are measured horizontally.

The Contractor is required to check all level information contained on the Contract Drawings and notify the Superintendent of any apparent discrepancies prior to the commencement of Contract Work.

The Contractor shall construct the works in strict conformity with the alignment information shown, except where otherwise directed in writing by the Superintendent.

The Contractor shall be responsible for maintaining the survey monuments and the various control lines regardless of whether they have been set out by the Superintendent or his representative or the Contractor. Before lines are affected by construction operations, the Contractor shall transfer such monuments to side positions clear of operations and shall inform the Superintendent in writing of the extent of such movement. The Superintendent or his authorised representative shall be present when monuments are moved and the Contractor shall give a minimum of 24 hours notice to ensure same.

15 Concrete

15.1 GENERAL SPECIFICATION FOR THE SUPPLY OF READYMIX CONCRETE

This section of the specification outlines the requirements for the supply of concrete, additional to the requirements of AS 1379 and to the supply and manufacture of mortar and grout.

All concrete form work shall comply with AS 3600 and the associated codes nominated therein. Reinforcement shall comply with AS 4671.

All form work shall be designed in accordance with the Form Work Code AS 3610. The form work surface shall be in accordance with AS 3610 Section 3. Unless noted otherwise Class 2 Form Work shall be used for exposed surface in the case. Stripping of form work shall comply with AS 3600, Section 19.6.2. Stripping earlier than nominated in AS 3600 will only be permitted by the Superintendent if early age (e.g. E7) concrete test results are made available to the Superintendent and subsequent calculation show that this is possible.

Minimum cover shall comply with AS 3600 and shall be 50 mm unless noted otherwise.

All concrete shall be thoroughly vibrated into its final position.

15.2 REFERENCED DOCUMENTS

AS 1012	Methods for testing concrete
AS 1129	Fly Ash for use in concrete
AS 1130	Code of Practice for Use of Fly Ash in Concrete
AS 1141	Methods for sampling and testing aggregates
AS 1302	Steel reinforcing bars for concrete
AS 1379	The Specification and supply of concrete
AS 1478	Chemical admixtures for use in concrete
AS 2349	Method of sampling Portland and blended cement
AS 2758.1	Aggregates and rock for engineering purposes—concrete aggregates
AS 3582.1	Supplementary cementitious material for use with Portland cement—fly ash
AS 3582.2	Supplementary cementitious material for use with Portland cement—slag-ground granulated iron blast-furnace

AS 3600	Concrete structures
AS 3799	Liquid membrane-forming curing compounds for concrete
AS 3972	Portland and blended cements
SAA HB 79	Alkali Aggregate reaction—Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia.

15.3 QUALITY ASSURANCE

The concrete suppliers covered by this Specification shall be capable of demonstrating certification of their quality management system to the Australian Quality System Standard (AS/NZS ISO9001, AS/NZS ISO9002, AS/NZS ISO9003) by third-party organisations certified to the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).

15.3.1 Submission of certificates and samples

The Concrete Supplier shall submit copies of test certificates from NATA registered laboratories, covering cement, supplementary cementitious materials, chemical admixtures, and aggregates to indicate their compliance with the relevant requirements of Section 16.4 of this specification. Mixing water shall be in accordance with Section 16.4.7. Alternatively, samples of materials shall be submitted for testing to a laboratory with NATA registration for the relevant tests.

Such certificates or samples shall be submitted prior to, or with, the concrete mix details and at any other time specified herein or in accordance with AS 1379.

Certificates produced by the suppliers of aggregates etc will be acceptable.

15.3.2 Materials to be tested

The certificates from NATA-registered laboratories or samples required under Section 16.4.1 of this specification shall relate to materials already stockpiled at the aggregate plant (quarry) or at nominated location, for use under the contract or to the most recent production or materials from the source and of the quality intended for use.

15.3.3 Batching scales

Batching scales shall be calibrated in accordance with AS 1379 by an independent supplier with NATA registration for the appropriate tests. The reference to the calibration status shall be readily accessible.

15.4 MATERIALS FOR CONCRETE

All materials used in producing concrete, mortar and grouts shall satisfy the requirements of the relevant standards listed in Section 16.2 of this specification, except where modified by the special requirements of this specification. No concrete, mortar or grout shall be supplied before the conformance of all constituent materials is verified by test certificates from NATA registered laboratories.

15.4.1 Cement

Cements shall comply with AS 3972–1997—Portland and Blended Cements.

Only Portland or Blended Cements shall be used. The source of supply of any type of cement shall not be changed without prior notification and verification of conformance by test certificates from NATA-registered laboratories.

15.4.2 Aggregate

Fine and coarse aggregates for concrete shall comply with the requirements of AS 2758.1, except where special requirements are specified in this section. In reinforced concrete, the maximum size of aggregates shall not exceed one-half the minimum spacing between reinforcing bars or 20 mm, whichever is the lesser. Unreinforced concrete shall have a maximum size aggregate of 40 mm except where larger size aggregates are specified for mass concrete when limitations on temperature rise are necessary.

15.4.3 Fine aggregate

Fine aggregate shall consist of clean, hard, tough, durable, uncoated grains, uniform in quality, comprising of material of which not less than 90% passes the 4.75 mm sieve and shall have a range of sizes down to material passing 150 µm sieve with a water absorption not exceeding 2.5%. It shall comply generally with the requirements and tolerances as detailed in AS 2758.1 for fine aggregate, with the exception that the grading shall be given in Table 16.1.

Table 15.1 Fine aggregate grading

Australian standard sieve aperture (mm)	% Passing by mass of sample
9.5	100
4.75	90–100
2.36	65–100
1.18	40–85
600	25–60
300	10–30
150	2–10
75	0–4

15.4.4 Coarse aggregate

Coarse aggregate shall consist of dense natural material with water absorption not exceeding 2.5%. Natural material may be sourced from alluvial gravel/rock or quarried rock. The coarse aggregate may or may not be crushed and/or sieved to obtain the required particle grading.

15.4.5 Particle shape

The proportion of misshapen particles determined in accordance with AS 1141, Section 14, using a 2:1 ratio shall not exceed 35%.

15.4.6 Water

All water used for mixing concrete, grouts and mortar shall conform to AS 1379 Section 2.4.

15.4.7 Chemical admixtures

Chemical admixtures, unless specifically excluded, shall comply with AS 1478 and shall be used in accordance with AS 1379. Calcium chloride shall not be used as a concrete admixture.

Total alkali contribution (measured as Na_2O equivalent) of all admixtures shall not exceed 0.20 kg/m^3.

15.4.8 Restrictions on chemical content in cement

For water retaining concrete, the acid-soluble content of concrete from all mix sources, expressed as the proportion of SO_3 by mass, shall not exceed 20 g/kg of cement.

15.5 CONCRETE MIX DESIGNS

Concrete shall consist of a mixture of cement, water, fine aggregate and coarse aggregate, and may, if approved, include special admixtures or additives. The concrete shall satisfy the strength and durability requirement specified when in the finished work, which is sound and dense, free of voids and honeycombing or segregation, and with exposed surfaces meeting the surface finish specifications.

The proportion of fine aggregate to coarse aggregate will depend upon the grading and other properties of the materials, but the amount of fine aggregate shall always be the minimum, which when combined with the cement, will produce only sufficient mortar to fill the voids between the coarse aggregate and leave a slight excess for finishing.

In order to secure the optimum strength and durability of the finished concrete, the quantity of water to be used in mixing the concrete shall be the minimum which will give satisfactory workability and consistency, having regard to the conditions and manner of placing the concrete in the work, while complying with the specified maximum water-cement ratio.

The concrete supplier shall, before the supply of any concrete, mortar or grout, submit the details of the mix to be used on, or with reference to, test certificates from NATA registered laboratories which verify the strength performance in accordance with the appropriate Australian Standard, and also details of the proposed concrete supplier and/or batch plant.

Laboratory trial mixes shall be performed and test results notified on certificates from NATA registered laboratories if:

- the proposed mix design, additives or admixtures vary from the normal production of the nominated supplier and/or batch plant
- a site batch plant is proposed.

15.6 CLASSIFICATIONS OF CONCRETE

Concrete used in the Works shall be manufactured in accordance with this Specification, in grades having properties as listed in Table 15.2.

Table 15.2 Classification of concrete

Concrete grade	Cement type	Minimum cement (binder) content (kg/m^3)	Nominal slump (mm)	Maximum water/ cement (water/binder) ratio	Minimum characteristic strength F'c at 28 days (Mpa)
N20	General purpose	—	80	—	20
N25	General purpose	—	80	—	25
N40	General purpose	360	80	0.45	40
Stabilised sand	General purpose	25:1 (sand:cement)	n/a	n/a	n/a

Notes:

N20 Shall be used for all pipe encasement and anchor blocks and as blinding concrete and overbreak concrete.

N25 Shall be used for minor concrete works including kerbs, gutters, dishdrains, stormwater drainage pits, surface water pits, mass concrete stairs, footpaths, mowing strips, laybacks, electrical pits and for all pipe encasement and anchor blocks.

N40 Shall be used for fibre reinforced concrete.

15.6.1 No fines concrete

No-fines concrete shall consist of Portland Cement and coarse aggregate. Portland Cement shall comply with this Specification. Coarse aggregate shall comply with the grading shown in Table 15.3.

Table 15.3 Coarse aggregate grading

AS 1152	Sieve size (%) passing (10 mm Nom)	Sieve size (%) passing (20 mm Nom)
26.5 mm	—	100
19 mm	—	85–100
13.2 mm	100	0-10
9.5 mm	85–100	0-5
4.75 mm	0–10	0
0.075 mm	0–2	0

Minimum cement content shall be 250 kg/m^3.

The water–cement ratio shall be 0.5–0.55 by weight.

No-fines concrete shall be screeded to the required surface levels without tamping, rodding or vibrating. Before granular pavement material is placed over No Fines concrete, the surface shall be covered with BIDDIM A44 Geotextile or equivalent. Before normal concrete is poured over no-fines, the surface shall be covered with two layers of 200 µm PVC membrane. No fines concrete shall be placed at the thickness detailed on the drawings.

15.7 PRODUCTION AND DELIVERY

15.7.1 General

All concrete, mortar and grout shall be supplied as notified in accordance with Section 16.6 of this specification. The requirements of AS 1379, Sections 3 and 4 and Appendix A, shall be applied, except where modified by this specification and irrespective of the mix being concrete, mortar or grout, pre-mixed or site-mixed.

The production and transport shall be such as to:

- limit segregation or loss of materials
- supply a homogeneous product
- result in concrete workability at the time of incorporating in the works, which is compatible with the capacity of the placing equipment to achieve the full compaction, form and surface finish.

15.7.2 Mixing

General

Mixing shall comply with AS 1379.

Mixing times

The minimum mixing time shall comply with AS 1379.

When by reason of delay it is necessary to hold a batch in the mixer, mixing may be continued for a maximum of ten minutes, except for split drum mixers for which a maximum of five minutes shall apply.

Stand-by plant

The Contractor shall nominate a back-up batching plant to be used in the event of a breakdown or other emergency.

Hand mixing

In the case of a breakdown of the mechanical mixing equipment, approval may be given to hand mix small quantities so as to reach a support or a suitable location for a construction joint. In the event of hand mixing being approved, an extra 10% cement shall be added to the mix and the water/cement ratio shall be maintained.

Re-tempering

Concrete which has commenced to harden before being placed shall not be re-tempered and shall be rejected.

15.7.3 Delivery

General

Delivery shall comply with the following requirements:

- The mixed concrete with a slump exceeding 50 mm shall be delivered in an agitating vehicle. Do not add water on site.

- Agitating vehicles shall be used to deliver concrete, which will be hand placed.

Identification certificate

An identification certificate bearing the information required by AS 1379, shall be provided with each load delivered. Copies of the certificates shall be retained by the Contractor to record deliveries and shall be made available on request.

Time from charging to incorporating in works

The Contractor shall be responsible for ensuring that the delivery time up to the incorporation in the works complies with the requirements of Table 15.4. Incorporation in the work shall be determined as the time that compaction is completed.

Any portion of a batch that fails to meet the requirements of Table 15.4 shall be rejected.

Table 15.4 Maximum time from charging to incorporating in works

Concrete temperature at time of discharge	Maximum elapsed time from addition of water to incorporation in works
DELIVERY IN AGITATING TRUCKS	
<5ºC	Not permitted under this specification
5–24ºC	2 hours
24–27ºC	1 hour 30 minutes
27–32ºC	1 hour
32–35ºC	45 minutes
>35ºC	Not permitted under this specification
SITE MIXING AND/OR DELIVERY IN NON-AGITATING TRUCKS	
5–32ºC	45 minutes
32–35ºC	30 minutes

Mixing in hot weather

Hot weather mixing

The temperature of any batch shall not exceed 35ºC at the time of discharge excepting those mixes that are for elements over 400 mm thick in which case a maximum of 30ºC shall apply. Where necessary, one or more of the following procedures shall be employed to ensure the maximum temperature is not exceeded:

- use of chilled mixing water
- addition of ice to the mixing water (no ice particle shall remain by the time of discharge of the concrete)
- cooling of the coarse aggregate by shading and/or cold water spraying of the stockpiles.

15.8 TESTING

Sampling and Testing of fresh and hardened concrete in accordance with AS 1379 shall be carried out to ensure that all specified performance requirements are satisfied. All sampling and testing required shall be performed by the Concrete Supplier at the Concrete Supplier's expense. The Concrete Supplier shall supply copies of the certificates from NATA registered laboratories for all testing carried. Concrete Supplier's identification certificates shall be submitted in accordance with AS 1379.

All testing equipment must be calibrated by NATA registered suppliers at a frequency sufficient to ensure maintenance of NATA registration.

The Concrete Supplier shall use only trained, competent personnel, operating facilities and equipment certified where required by NATA registered suppliers, for the taking of samples and specimens and the preparation of materials and work for testing.

Samples shall be taken in accordance with AS 1012.1. Records shall be kept by the Contractor of all aspects of sampling and be made available on request.

The sampling, testing and acceptance shall be carried out in accordance with AS 1379, and at the minimum frequencies shown in Table 15.5. This sampling frequency may be increased or decreased as considered necessary after consistency of results has been assessed.

Table 15.5 Concrete sampling and testing frequency

Location of concrete	Normal	Frequency of sampling minimum
Footings	1 per 50 m³	1 per building
Slab on ground	1 per 50 m³	1 per slab or cast section of slab
Blinding	0	

The concrete supplier shall take concrete samples at the point of discharge from the truck. Each sample shall consist of at least:

- a slump test. (Concrete slump shall be 80 mm unless nominated otherwise on the drawings. Tremie concrete slump shall be 160 mm)
- three standard cylinders—one tested at seven days
- two tested at 28 days
- temperature measurement of the mix—when requested by the Project Construction Manager or his nominated representative.

Records of all plant and control sampling and tests shall be kept in accordance with this Specification and AS 1379.

15.8.1 Slump

All batches of concrete tested in accordance with AS 1012.3 which fail to conform to the slump specified, or for which the slump measured is outside the usual range for that particular mix, shall be positively identified and shall not be incorporated in the work.

Unless otherwise specified (e.g. for pumped or self levelling concrete), the concrete mix shall have the slump values of:

- for mass concrete—80 mm nominal
- for reinforced concrete and all other concrete—80 mm nominal.

15.8.2 Compressive strength

Testing shall be required to confirm compliance of compressive strength and shall be carried out in accordance with AS 1012. At least three specimens shall be cast concurrently from each sample. These specimens shall be prepared, cured and transported in accordance AS 1012 excepting specimens to be tested for early compressive strength which, shall be stored and cured under the same conditions as the concrete they represent. Frequency of sampling shall be in accordance with AS 1379.

15.8.3 Flexural strength

Flexural strength testing shall be carried out in accordance with AS 1012.1. Testing frequency shall be one per slab. All samples tested to achieve characteristic flexural strength of 4 MPa. Sample shall be taken from a concrete delivered with an 80 mm slump.

15.9 ACCEPTANCE AND REJECTION CRITERIA

15.9.1 Rejection and removal

Any concrete, mortar or grout which cannot be shown to satisfy the relevant criteria specified for slump in accordance with AS 1379 or compressive strength shall be liable to rejection. Where material has been rejected, it shall not be incorporated in the work. Incorporated concrete that is rejected shall be removed and replaced by the Contractor with material conforming to the contract specifications. All costs associated with the rejection, removal and replacement of the deficient work shall be borne by the Concrete Supplier.

Concrete which cannot be shown to satisfy the requirement for strength and durability due to porosity, segregation, surface defects, honey-combing, excessive bleeding or otherwise caused voids or inclusion of other material and/or inadequate placing or curing procedures, will be rejected, removed and replaced at the Contractors expense.

15.9.2 Sample representation

The test results of any sample shall be deemed to be representative of all of that particular mix supplied since the previous sample was taken to determine the property in question.

15.9.3 Standard deviations

The standard deviation of a controlled grade shall be determined in accordance with AS 1379. When less than 30 samples are available the standard deviation shall be determined as given in Table 15.6. Where sufficient test results are available for a

similar strength concrete from the same batch plant the standard deviation for that concrete may be used.

Table 15.6 Assumed standard deviations

Characteristic strengths 'fc' MPa	Assumed standard deviation 's' MPa
20	4.5
25	4.8
32	5.2
40	5.9

15.9.4 Acceptance criteria—strength

Compliance of an element, batch or lot of concrete with the specified characteristic strength for the grade specified shall be determined in accordance with AS 3600 using the production assessment appropriate to the concrete supply.

15.9.5 Acceptance criteria—shrinkage

Compliance of an element, batch or lot of concrete with the specified maximum drying shrinkage for N grades shall not exceed 400 microstrain at 56 days as determined by AS 1012, with an acceptance tolerance of maximum +20%.

15.10 STEEL FIBRE TYPE AND DOSAGE

While all Dramix steel fibres for flooring applications have the same hooked-end configuration, the fibre type (length, diameter and tensile strength) varies depending on specific project conditions. Steel fibre shall be Dramix (or equivalent) mixed in accordance with Section 16.11 of this specification. Fibre to be used is RC 65/60–BN at a dose rate of 30 kg/m^3.

15.11 BATCHING CONSIDERATIONS FIBRE REINFORCED CONCRETE

15.11.1 General

A central batching mixer shall be used to mix the Fibre Reinforce concrete. A continuous aggregate grading shall be used. The concrete is to be mixed until all glued fibres are separated into individual fibres.

If special cements or admixtures are used, a preliminary test is shall be conducted to determine the concrete strength at seven days and 28 days in accordance with AS 1379.

15.11.2 Fibre addition

In batching plant mixer

Fibres shall not be added as the first component in the mix. Fibres can be introduced together with sand and aggregates, or can be added in freshly mixed concrete.

Only for drummixer: unopened degradable bags can be thrown directly in the mixer

Truckmixer

The drum speed of the mixer will be between 12 rpm and 18 rpm. Adjust the slump to a minimum of 12 cm, preferably with water reducing agents or high water reducing agents. Fibres may be added with a maximum speed of 60 kg per minute. Provided that the drum speed is a minimum of 12 rpm, unopened degradable bags can be added. Optional equipment for dosing fibres is a belt-hoist elevator. After adding the fibres, mixing at highest speed shall continue for 4–5 minutes (±70 rotations)

Automatic dosing

Fibres can be dosed from bulk at rates from 0 kg per second up to 3.5 kg per second with specially developed dosing equipment.

15.12 SOIL SUPPORT SYSTEM

The soil support system should be well drained and provide adequate and uniform load-bearing support. Specific attention should be given to the site preparation requirements, including proof-rolling, because the performance of a slab on ground depends on the integrity of both the soil support system and the slab. The in-place density of the soil support system should be at least the minimum required by the specifications, and the base should be free of deleterious material before the concrete placing begins and able to support construction traffic such as loaded truck mixers.

Proof-rolling shall be used to determine that the soil support system is adequate to provide a uniformly stable and adequate bearing support during and after construction. Proof-rolling, observed by the superintendent, shall be accomplished by a loaded tandem axle dump truck, a load truck mixer, roller, or equivalent. In any case, multiple passes should be made using a pre-established grid pattern.

If rutting or pumping is evident at any time during the preparation of the soil support system, repairs such as, but not limited to, raking smooth or compacting with suitable compaction equipment should be undertaken. ‘Rutting’ normally occurs when the surface of the base is wet and the underlying soils are firm. ‘Pumping’ normally occurs when the surface of the base is dry and the underlying soils are wet. Any depression in the surface deeper than 13 mm should be repaired.

The tolerance of the sub-base should follow the local standards or jobsite specification with maximum tolerances of:

- ±10 mm for $h \leq 150$ *mm*
- ±30 mm for $h \geq 400$ *mm*

- linear interpolation between 150 mm and 400 mm for corresponding maximum tolerances.

15.13 AGGREGATES

Aggregates should conform to industry standards such as ASTM C 33. Combined aggregate gradations should conform to industry standards such as ACI 544.1R8. A uniform gradation is necessary to produce a desirable matrix while reducing water demand of the concrete mixture and reducing the amount of cement paste required to coat the aggregates and steel fibres.

15.14 CURING

15.14.1 Curing

Concrete shall be cured continuously for a period of at least seven days that ensures that the design requirements for strength, serviceability and stripping are satisfied and that 90% water retention after 72 hours is achieved. To satisfy durability requirements, the initial curing periods shall be not less than those given in Clauses 4.4 to 4.6 of AS 3600.

Curing shall be achieved by the application of water or steam to, or the retention of water in, the freshly cast concrete and shall commence as soon as practicable after finishing of any unformed surfaces has been completed. Where retention of water in the fresh concrete relies on the application to exposed surfaces of sprayed membrane-forming curing compounds, the compounds used shall comply with AS 3799. Alternative curing methods shall be submitted to the Superintendent for review prior to implementation.

Masterkure 111CF (or approved equivalent) is to be added first when the concrete is being screeded followed by Masterkure 100 WB (or approved equivalent) after the concrete surface is finished.

15.14.2 Protection

Freshly cast concrete shall be protected from the effects rain, running water and freezing or drying prior to hardening. During the initial curing period the concrete shall be protected from freezing or drying.

15.15 WATER STOPS

250 mm wide Surestop PVC Rearguard RGX water stops (or approved equivalent) are to be used at the bottom over the entire length of all joints in the Barney Creek Haul Road Crossing slabs. Fixing of the Rearguard water stop in horizontal applications shall be achieved by laying the water stop on top of the vapour barrier centrally along the line of the joint being formed. Prefabricated intersections shall be used at all intersections of slabs. All joints are to be site welded using blades and jigs available from the supplier. All welds shall be carried out by appropriately trained, qualified, and experienced tradesmen. Care must be taken not to heat the PVC to the point of charring as the quality of the joint will be compromised and harmful fumes will be released.

15.16 JOINTS

10 mm Danley Diamond Dowel Joints (or approved equivalent) located at half the slab thickness (± 5%) shall be used for all fibre reinforced concrete joints. Parallel to the top of the slab one end of the nailing plate shall be no more than 3 mm higher than the other end of the plate. Perpendicular to the face of the dowel joint, the top of the sleeve at the apex shall be no more than 3 mm higher or lower than the face of the sleeve behind the nailing flange. Dowel plates are to be inserted in the sleeve as soon as practicable after pouring concrete and stripping formwork, and no later than 36 hours after pouring concrete. Joints shall be sealed as soon as practicable and maintained throughout the life of the pavement to ensure minimal change of moisture content in the sub-base and sub grade.

After stripping formwork 10 mm Stiff joint filler board is to be attached to the concrete face of the joint above and below the diamond dowel. The stiff joint can be cut with a Stanley knife such that the entire exposed face of the concrete joint can be covered with the stiff joint filler board. The filler board can be attached to the concrete using nails or glued using liquid nails or equivalent. The top 10 mm of the filler board has a zip top that is to be removed after the next concrete slab has been stripped of formwork. After the strip has been removed a 10 mm by 10 mm bead of Bostik Seal n Flex is to be applied to seal the joint.

15.17 SHRINK REDUCING AGENT

15.17.1 Mixing

Tetraguard AS21 (or approved equivalent) can be added during the batching process or on site. It is recommended that when added during the batching process, Tetraguard AS21 (or approved equivalent) is added to the initial batch water (as per a normal water reducer) to ensure complete distribution throughout the mix. When added on site, high speed agitation for 2–3 minutes is required to ensure complete distribution of the Tetraguard AS21 (or approved equivalent) throughout the mix.

Tetraguard AS21 (or approved equivalent) is to be added at a rate of 8 L/m^3 to reduce the effect of drying shrinkage to below 400 microstrain.

15.17.2 Compatibility

Tetraguard AS21 (or approved equivalent) can be used with other MBT admixtures to achieve cost affective customised performance. However, all admixtures should be dispensed separately and added separately to initial batching water to ensure complete distribution throughout the mix. Tetraguard AS21 (or approved equivalent) should not be used in conjunction with other admixtures unless specific test information is available.

15.18 SEALANTS

15.18.1 Surface preparation

Clean by grinding, sandblasting or wire brushing to expose a sound surface, free of contamination and laitance. Joints can be blown out using oil free compressed air or vacuum cleaned

15.18.2 Priming

Bostik N49 primer (or approved equivalent) is generally a one component primer for use on porous surfaces and serves as an adhesive agent between the concrete surfaces for the sealant system. It is the user's responsibility to check the adhesion of the cured sealant on typical test joints at the project site, before and during application, if the surface is unusual.

The concrete joint is to be masked prior to the application of the Bostik N49 primer and Bostik Seal-n-Flex FC sealer (or approved equivalent). Apply primer at full strength with a brush or clean cloth. A light, uniform coating is sufficient for most surfaces. Porous surfaces require a somewhat heavier, although not excessive, coat.

Allow primer to dry before applying Bostik Seal-n-Flex FC. Depending on the temperature and humidity, primer will be tack free in 15 minutes to two hours. Priming and sealing must be done on the same work day.

15.18.3 Application

Bostik Seal-n-Flex FC comes ready to use. Apply by professional caulking gun set to fill a 10 x 10 mm joint. Do not open cartridges or sausages, until preparatory work has been completed. Fill joints from deepest point to the surface by holding a suitably sized nozzle against the back of the joint. Dry tooling using a spatula or putty knife flush to finish is recommended. DO NOT use soapy water or solvents when tooling. Tooling results in the correct bead shape, a neat joint, and maximum adhesion. Excess sealant can be removed by a dry cloth or solvent wipe before curing. Masking tapes shall also be removed before curing.

For Best Performance protect unopened containers from heat and direct sunshine. In cool or cold weather, store container at room temperature for at least 24 hours before using.

15.19 FINISHING

The horizontal concrete surfaces shall be finished with a broom to ensure a non slip surface within the tolerances specified.

No holes, chases or embedments other than those shown on the drawings listed at Appendix A shall be made in concrete members without prior approval from the Superintendent.

15.20 TOLERANCES

Pavement slab tolerances shall be in accordance with AS 3600 and shall not exceed 1/200 times the specified dimension or 5 mm whichever is the greater. The deviation of any point on the surface of the pavement shall not exceed 1/250 times the length of the line or 10 mm which ever is the greater.

16 Initial rehabilitation

16.1 GENERAL

Topsoil management, erosion and sediment control during construction, rehabilitation requirements for the realigned channel sections and the flood protection levee and monitoring of rehabilitation will be contained in a site specific Environmental Management Plan.

16.2 FISH RESTING AREAS

Fish resting pools shall be incorporated as deeper sections along the bed of the new channel, as off-stream pools at the junctions with tributaries and side gullies and/or pools and riffles. Fish resting areas shall be provided in the new channels as indicated in the drawings but generally:

- *In rock areas:* Pools shall be located in areas of weaker rock at least 30 m long and at random spacings but at least two pools per 250 m along the length of the channel. The pools will be at least 0.5 m deep and extend at least 60% of the channel width.
- *In soil areas:* Pools shall be at least 30 m long and at random spacings but at least two pools per 120 m along the length of the channel. The pools will be up to 1.5 m deep and extend at least 50–60% of the channel width.
- *Behind riffles.* Riffles with a downstream face of 20H : 1V and an upstream face of 4H : 1V shall be formed by dumped rock with a nominal size of 450 mm. The depth of the pool formed by the riffle shall be approximately 1.5m and the spacing between riffles in alluvium shall be in accordance with the drawings.

16.3 LARGE WOODED DEBRIS (LWD)

LWD shall be provided to provide habitat for fauna and shall comprise locally won logs that shall be no less than 300 mm in diameter and at least 4 m in length.

Large woody debris (LWD) is to be placed in bed of channel to assist in rehabilitation, to provide habitat, encourage sediment trapping and meandering. LWD should comprise dead trees with Diameter Breast Height (DBH) 300 mm minimum preferably > 450 mm. Preference is for LWD with intact root ball and up to 8 m of the trunk, with a few main branches but not too much of the entire tree canopy.

LWD should be located at irregular spacing, placement, and alignment to resemble a random distribution. In channel sections with a sand/clay bed, the maximum spacing of LWD should be ~100 m with spaced as low as 30 m. In rock bed sections the maximum spacing of LWD should be 200 m.

LWD are to be placed irregularly on alternating sides of the river bed, with randomness. Near tributary junctions, LWD should be placed on the bank opposite to the side where the tributary joins. About 20–40% of LWD should be in groups of two or three logs placed to resemble a log jam. 'Log-jams' should be placed closer to the banks and should not obstruct more than 50% of channel bed.

Shallow loose sand (around 200–400 mm depth) should be placed on upstream and downstream side of logs to resemble sand bar. At least two thirds of LWD should be anchored. Anchoring may be achieved by partial (>25%) burying of the log and root ball, chaining to a timber pile driven into a sand or clay bed or chaining to a grouted steel bar in rock beds.

Approximately 60–80% of LWD should be aligned angled from the bank (about 30–60°) in downstream direction. The remainder should be perpendicular to bank and some pointing upstream.

In rock areas the LWD will be pinned into position at random locations at intervals not exceeding 200 m along the length of the diversion channel. The LWD will be fixed to the channel bed by at least two 'U' shaped pins fabricated from N32 galvanised reinforcing bar. The hold down pins will be inserted into pre drilled holes 70 mm in diameter and back filled with a non shrink grout with a compressive strength of at least 40 MPa. The holes in the bedrock will be at least 2150 mm deep. Galvanised chains with a SWL of 2 t will be used to shackle the LWD to the pins. All 'D' shackles or other connecting devices will have the same SWL as the chain.

In soil areas the LWD will be pinned into position at random locations at intervals not exceeding 100 m along the length of the diversion channel. The LWD will be fixed to the channel bed by at least three 450 mm diameter timber piles driven 3 m deep into the channel bed. The piles will extend 1 m above the channel bed. Galvanised chains with a SWL of 2 t will be used to connect the LWD to the piles. The chains will be fixed to the piles such that the chains cannot ride over the top of the piles as the water in the channel rises. All 'D' shackles or other connecting devices will have the same SWL as the chain.

16.4 TIMBER GROYNES

Timber groynes spaced at approximately 20m shall be placed in the vicinity of stream, river or channel junctions, as shown on the Drawings, to minimise the likelihood of bank erosion by trapping debris and sediment.

The timber groynes shall comprise up to ten (10) hardwood piles at 1.2m centres, each pile with a minimum diameter of 300mm. The piles shall be driven approximately 3m into alluvial materials and shall protrude approximately 1m above the surface of the channel.

16.5 ROCK FRACTURING

Where blasting is required to loosen weathered and fresh rock in diversion channels prior to excavation, the blasting shall extend 2m beyond the lines of the excavation when measured normal to the face of the excavation. The purpose of the blasting is to assist in the establishment of vegetation by fracturing the rock mass and allowing soil and moisture to penetrate the crevices.

16.6 TOP SOIL SPREADING

Where shown on the drawings, run of excavation rock is to be spread on excavation batters in alluvium. The purpose of the rock is as a temporary armouring to provide an environment where seeds can germinate and riparian vegetation can become established.

Topsoil shall be spread over the rock armouring located in the new channels and where bedrock has been deliberately fractured beyond the lines of the excavation. The topsoil shall be non dispersive and shall contain locally occurring grass and riparian vegetation seeds. Sluicing with water cannons may be undertaken to assist the topsoil in penetrating the dumped rock.

16.7 TREATMENT OF DISPERSIVE SOILS

Routine sampling of alluvium in diversion batters shall be undertaken to identify areas of potentially dispersive soils. If materials with an Emerson Class number equal to one (1) are identified, then they shall be protected with a 0.9m thick layer of run of excavation rock underlain by Bidim A44 geotextile or approved equivalent. Topsoil shall also be spread over the rock in accordance with Clause 16.6.

Appendix A

DRAWINGS

Appendix A

Drawing List

Drawing No.	Title
BEE508-C-DWG-001	Drawing Index & Locality Plan
BEE508-C-DWG-002	Levee & Diversions - Layout Plan
BEE508-C-DWG-003	Overburden Emplacement - Layout Plan
BEE508-C-DWG-004	Services Plan
BEE508-C-DWG-005	Stage 1 Construction Limits
BEE508-C-DWG-101	McArthur River Diversion Set out Details
BEE508-C-DWG-102	Longitudinal Section
BEE508-C-DWG-103	Typical Sections
BEE508-C-DWG-104	Typical Details – Inlet / Outlet
BEE508-C-DWG-105	Typical Bed Details
BEE508-C-DWG-106	Typical Details – Tributary Treatment Details
BEE508-C-DWG-107	Rock Chute Details Sheet 1 of 2
BEE508-C-DWG-108	Rock Chute Details Sheet 2 of 2
BEE508-C-DWG-109	Bull Creek Cascade Concept Design Sheet 1of 2
BEE508-C-DWG-110	Bull Creek Cascade Concept Design Sheet 2of 2
BEE508-C-DWG-201	Barney Creek Diversion Set out Details
BEE508-C-DWG-202	Longitudinal Section
BEE508-C-DWG-203	Typical Sections
BEE508-C-DWG-204	Surprise Creek Chute Details – Sheet 1 of 2
BEE508-C-DWG-205	Surprise Creek Chute Details – Sheet 2 of 2
BEE508-C-DWG-206	Typical Details - Tributary Treatment Details
BEE508-C-DWG-207	Typical Bed Details
BEE508-C-DWG-301	Levee Set out Details
BEE508-C-DWG-302	Longitudinal Section
BEE508-C-DWG-303	Levee Typical Sections – Initial Construction
BEE508-C-DWG-304	Tie in to Barney Hill at CH00
BEE508-C-DWG-305	Tie in to Barney Hill at CH 7261
BEE508-C-DWG-306	Temporary River Crossings Sheet 1 of 2
BEE508-C-DWG-307	Temporary River Crossings Sheet 2 of 2
BEE508-C-DWG-308	Mine Levee Wall Final Arrangement
BEE508-C-DWG-501	Haul Road Set out Details
BEE508-C-DWG-502	Longitudinal Section
BEE508-C-DWG-503	Typical Haul Road Sections – Pavement Details
BEE508-C-DWG-504	Safety Bund and Drainage Details

Appendix B

SURVEILLANCE PLAN

KBR	SURVEILLANCE PLAN*	Document No: Approved By:	BEE508-2-SPEC-001	Sheet 1 of 2
Project No. and Title:	BEE508 – McArthur River Mine Expansion Project – Civil Works	Revision:	0	
Contract No. and Title:		Date:	TBA	

Item		References		Acceptance Criteria	Surveillance Activity		
No.	Description	Contract	Contractor's ITP		Type	Freq.	Comments
1	**GENERAL REQUIREMENTS**						
1.1	Review of Quality System				DR	1	
1.2	Review of subcontractors				DR	1	
1.3	Review of ITPs			. 0	DR	1	Prior to start of work in each case.
1.4	Review of Safe Work Procedures by Project Manager			Contractor's Quality System	C	1	
1.5	Compliance Audit—Industrial relations/Records			Contractor's Quality System	A	1	Prior to start on site
1.6	Compliance Audit—Monthly Payment to Employee Schemes			Affidavit	H	Per Payment	Payments current to each payroll
1.7	Review of Contractor induction records			Completed	H	1	Prior to commencement
1.8	Weekly Safety Reports			Completed	F	As requested weekly	Audits Mondays

LEGEND A–Audit C–Spot Check H–Hold I–Inspection T–Test W–Witness DR–Document Review * This form can be used for both project and contract surveillance plans. If to be used for the latter, enter the Contract No. and title.

KBR	SURVEILLANCE PLAN*	Document No: Approved By:	BEE508-2-SPEC-001	Sheet 2 of 2
Project No. and Title:	BEE508 – McArthur River Mine Expansion Project	Revision:	0	
Contract No. and Title:		Date:	TBA	

Item		References		Acceptance Criteria	Surveillance Activity		
No.	Description	Contract	Contractor's ITP		Type	Freq.	Comments
2	**REQUIREMENTS—CONSTRUCTION**						
2.1	Review of Methodology			As Per contract documentation	DR		Prior to commencement
2.2	Set-out			As per drawing	W		Prior to installation
2.3	Design Certification			Form 13	H	1	14 days prior to commencement
2.4	As Built Certification			Form 14	H	1	On completion
3	**FIELD TESTS – ZONE 1: A, B, C MATERIAL**						
3.1	Dry Density Ratio	Section 8.11		(a) Not less than 80% of tests within each lot shall comply with the minimum requirement for the material or Zone being tested. (b) Any remaining non-complying results shall be within no more than 2% below specified minimum	T	10 per 10,000 m^3	AS1289.5.8.1
3.2	Moisture Ratio	Section 8.11		a) Not less than 80% of tests within each lot shall comply with the minimum requirement for the material or Zone being tested.	T	10 per 10,000 m^3	

				(b) Any remaining non-complying results shall be within no more than 0.1 outside specified range.			
3.3	Particle Size Distribution	Section 8.6 Section 8.7 Section 8.8		a) Not less than 80% of tests within each lot shall comply with the minimum requirement for the material or Zone being tested. (b) Any remaining non-complying results shall be within no more than 2% outside specified range (for every sieve size).	T	2 per 20,000 m^3	AS1289.3.6.1
3.4	Plasticity Index	Section 8.6 Section 8.7 Section 8.8		a) Not less than 80% of tests within each lot shall comply with the minimum requirement for the material or Zone being tested. (b) Any remaining non-complying results shall be within no more than 3% outside specified range.	T	2 per 20,000 m^3	AS1289.3.3.1
3.5	Emerson Crumb Dispersion	Section 8.6 Section 8.7		Not less than 80% of tests within each lot shall comply with the minimum requirement for the material or Zone being tested.	T	5 per 20,000 m^3	AS1289.3.8.1
4	**FIELD TESTS – BASE MATERIAL**						
4.1	Dry Density Ratio	Section 9.3		(a) Not less than 80% of tests within each lot shall comply with the minimum requirement for the material or Zone being tested. (b) Any remaining non-complying results shall be within no more than 2% below specified minimum	T	4 per 10,000 m^3	AS1289.5.8.1
4.2	Moisture Ratio	Section 9.3		a) Not less than 80% of tests within each lot shall comply with the minimum requirement for the material or Zone being tested. (b) Any remaining non-complying results shall be within no more than 0.1 outside specified range.	T	4 per 10,000 m^3	

4.3	Particle Size Distribution	Section 9.3		a) Not less than 80% of tests within each lot shall comply with the minimum requirement for the material or Zone being tested. (b) Any remaining non-complying results shall be within no more than 2% outside specified range (for every sieve size).	T	2 per 20,000 m^3	AS1289.3.6.1
4.4	Plasticity Index	Section 9.3		a) Not less than 80% of tests within each lot shall comply with the minimum requirement for the material or Zone being tested. (b) Any remaining non-complying results shall be within no more than 3% outside specified range.	T	2 per 20,000 m^3	AS1289.3.3.1
4.5	Los Angeles Abrasion	Section 9.3			T	2 per 20,000 m^3	AS1141.23
5	**FIELD TESTS – SUBBASE MATERIAL**						
5.1	Dry Density Ratio	Section 9.3		a) Not less than 80% of tests within each lot shall comply with the minimum requirement for the material or Zone being tested. (b) Any remaining non-complying results shall be within no more than 2% below specified minimum	T	4 per 10,000 m^3	AS1289.5.8.1
5.2	Moisture Ratio	Section 9.3		a) Not less than 80% of tests within each lot shall comply with the minimum requirement for the material or Zone being tested. (b)Any remaining non-complying results shall be within no more than 0.1 outside specified range.	T	4 per 10,000 m^3	
5.3	Particle Size Distribution	Section 9.3		a) Not less than 80% of tests within each lot shall comply with the minimum requirement for the material or Zone being tested.	T	2 per 20,000 m^3	AS1289.3.6.1

				(b) Any remaining non-complying results shall be within no more than 2% outside specified range (for every sieve size).			
5.4	Plasticity Index	Section 9.3		a) Not less than 80% of tests within each lot shall comply with the minimum requirement for the material or Zone being tested. (b) Any remaining non-complying results shall be within no more than 3% outside specified range.	T	2 per 20,000 m^3	AS1289.3.3.1
5.5	Los Angeles Abrasion	Section 9.3			T	2 per 20,000 m^3	AS1141.23
6	**FIELD TESTS – SUBGRADE MATERIAL**						
6.1	Dry Density Ratio	Section 9.3		a) Not less than 80% of tests within each lot shall comply with the minimum requirement for the material or Zone being tested. (b) Any remaining non-complying results shall be within no more than 2% below specified minimum	T	2 per 10,000 m^3	AS1289.5.8.1
7	**FIELD TESTS – SLAB TO GROUND**						
7.1	Strength	Section 15.9		determined in accordance with AS 3600 using the production assessment appropriate to the concrete supply	T	1 per 50 m^3 or minimum 1 per slab	AS 1012.1 (taking of sample) AS 1379
7.2	Shrinkage	Section 15.9		shall not exceed 400 microstrain at 56 days as determined by AS 1012.	T	1 per 50 m^3 or minimum 1 per slab	AS 1012.1 (taking of sample) AS 1379

7.3	Temperature	Section 15.4		in accordance with table 16.4	T	1 per Truck Load	AS 1012.1 (taking of sample) AS 1379
7.4	Slump	Section 15.8		not less than 80 mm	T	1 per Truck Load	AS 1012.1 (taking of sample) AS 1379
LEGEND A–Audit C–Spot Check H–Hold I–Inspection T–Test W–Witness DR–Document Review * This form can be used for both project and contract surveillance plans. If to be used for the latter, enter the Contract No. and title.							

McARTHUR RIVER MINE EXPANSION PROJECT JOB No: BEE508

JUNE 2006

DRAWING INDEX

GENERAL

DRAWING No	CAD FILE No	DRAWING TITLE
001	BEE508-C-DWG-001	DRAWING INDEX & LOCALITY PLAN
002	BEE508-C-DWG-002	LAYOUT PLAN - LEVEE & DIVERSIONS
003	BEE508-C-DWG-003	LAYOUT PLAN - OVERBURDEN EMPLACEMENT
004	BEE508-C-DWG-004	SERVICES PLAN
005	BEE508-C-DWG-005	STAGE 1 CONSTRUCTION LIMITS

McARTHUR RIVER DIVERSION

DRAWING No	CAD FILE No	DRAWING TITLE
101	BEE508-C-DWG-101	SETOUT DETAILS
102	BEE508-C-DWG-102	LONGITUDINAL SECTIONS
103	BEE508-C-DWG-103	TYPICAL SECTIONS
104	BEE508-C-DWG-104	TYPICAL DETAILS - INLET/OUTLET
105	BEE508-C-DWG-105	TYPICAL BED DETAILS
106	BEE508-C-DWG-106	TYPICAL DETAILS - TRIBUTARY TREATMENT DETAILS
107	BEE508-C-DWG-107	ROCK CHUTE DETAILS - SHEET 1 OF 2
108	BEE508-C-DWG-108	ROCK CHUTE DETAILS - SHEET 2 OF 2
109	BEE508-C-DWG-109	BULL CREEK CASCADE CONCEPT DESIGN - SHEET 1 OF 2
110	BEE508-C-DWG-110	BULL CREEK CASCADE CONCEPT DESIGN - SHEET 2 OF 2

BARNEY CREEK DIVERSION

DRAWING No	CAD FILE No	DRAWING TITLE
201	BEE508-C-DWG-201	SETOUT DETAILS
202	BEE508-C-DWG-202	LONGITUDINAL SECTION
203	BEE508-C-DWG-203	TYPICAL SECTION
204	BEE508-C-DWG-204	SURPRISE CREEK CHUTE DETAILS - SHEET 1 OF 2
205	BEE508-C-DWG-205	SURPRISE CREEK CHUTE DETAILS - SHEET 2 OF 2
206	BEE508-C-DWG-206	TYPICAL DETAILS - TRIBUTARY TREATMENT DETAILS
207	BEE508-C-DWG-207	TYPICAL BED DETAILS

LEVEE

DRAWING No	CAD FILE No	DRAWING TITLE
301	BEE508-C-DWG-301	SETOUT DETAILS
302	BEE508-C-DWG-302	LONGITUDINAL SECTION - INITIAL CONSTRUCTION
303	BEE508-C-DWG-303	TYPICAL SECTIONS - INITIAL CONSTRUCTION
304	BEE508-C-DWG-304	TIE-INS TO BARNEY HILL CH 640
305	BEE508-C-DWG-305	TIE-INS TO BARNEY HILL CH 3261
306	BEE508-C-DWG-306	TEMPORARY RIVER CROSSINGS - SHEET 1 OF 2
307	BEE508-C-DWG-307	TEMPORARY RIVER CROSSINGS - SHEET 2 OF 2
308	BEE508-C-DWG-308	FINAL ARRANGEMENT

HAUL ROAD

DRAWING No	CAD FILE No	DRAWING TITLE
501	BEE508-C-DWG-501	SETOUT DETAILS
502	BEE508-C-DWG-502	LONGITUDINAL SECTION
503	BEE508-C-DWG-503	TYPICAL HAUL ROAD SECTIONS - PAVEMENT DETAILS
504	BEE508-C-DWG-504	SAFETY BUND AND DRAINS DETAILS

N

LOCALITY PLAN
NTS

xstrata

NOT FOR CONSTRUCTION

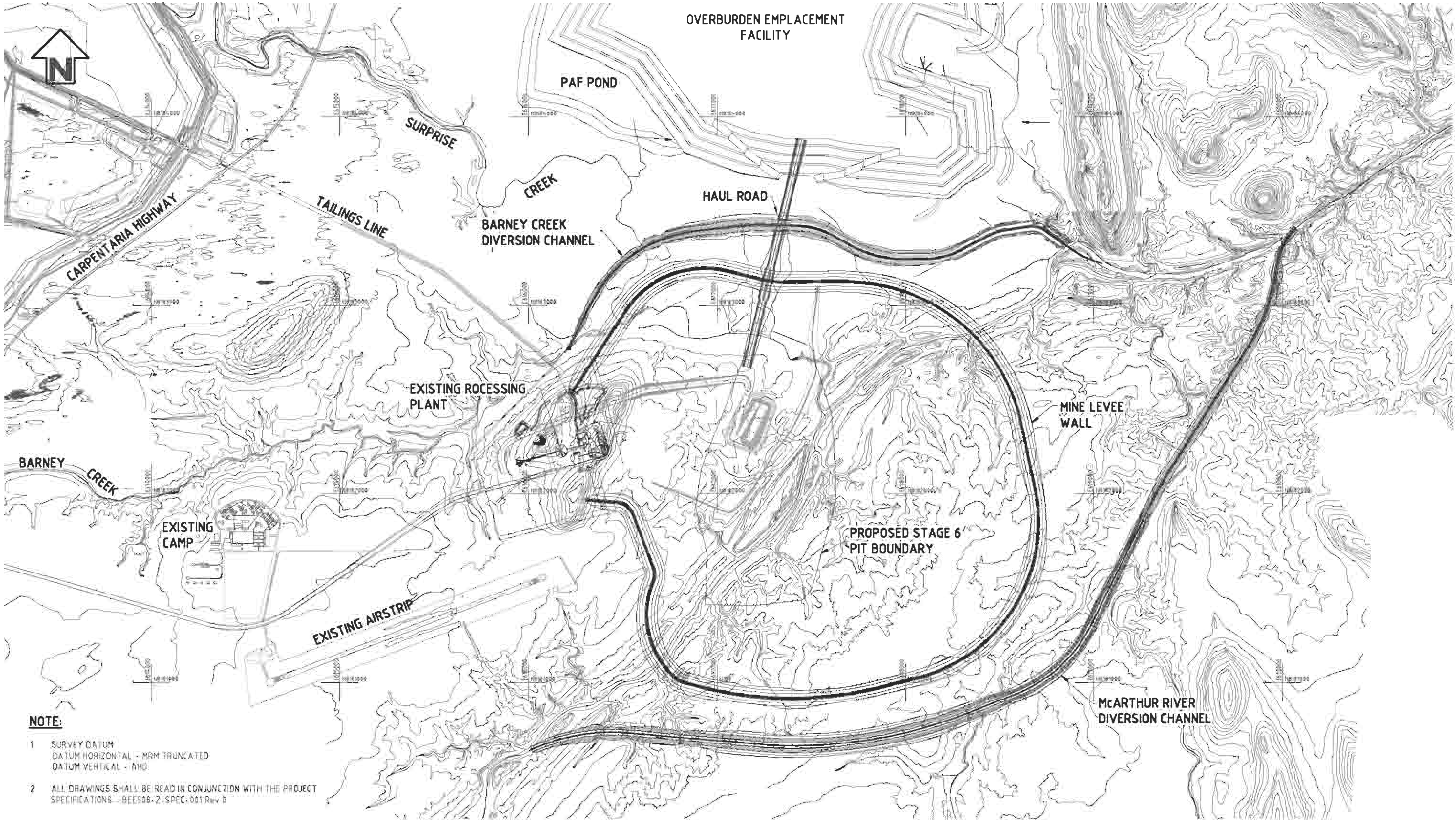
REV	DESCRIPTION	DATE
G	MATCH CHANGES	
F	MATCH & GRS CHANGES	
E	MATCH CHANGES	
D	MATCH & GRS MARKUPS	
C	MATCH & GRS MARKUPS	
B	DRAWING INDEX AMENDED	
A	ISSUE FOR REVIEW	

Kellogg Brown & Root Pty Ltd
KBR

SCALE: NTS | SIZE: A1 | PROJECT No: BEE508

TITLE: McARTHUR RIVER MINE EXPANSION PROJECT DIVERSION CHANNELS DRAWING INDEX & LOCALITY PLAN

DRAWING No: BEE508-C-DWG-001 | REVISION: G



NOTE:

1 SURVEY DATUM
DATUM HORIZONTAL - MRM TRUNCATED
DATUM VERTICAL - AHD

2 ALL DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE PROJECT SPECIFICATIONS - BEE508-2-SPEC-001 Rev 0

LAYOUT PLAN
SCALE 1:10000

xstrata

NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE
E	MATCH & URS CHANGES	22.06.06
D	OEF LAYOUT AMENDED	19.04.06
C	BARNEY CREEK ALIGNMENT CHANGED	21.02.06
B	MINE LEVEE WALL AMENDED	16.02.06
A	ISSUE FOR REVIEW	21.12.05

APPROVALS	NAME	SIGNATURE
DRAFTING	S.LINK	
DESIGN	G.DUGDALE	
DESIGN VERIFICATION	D.LOVELL	
PROJECT APPROVAL	D.VENESS	
CLIENT		

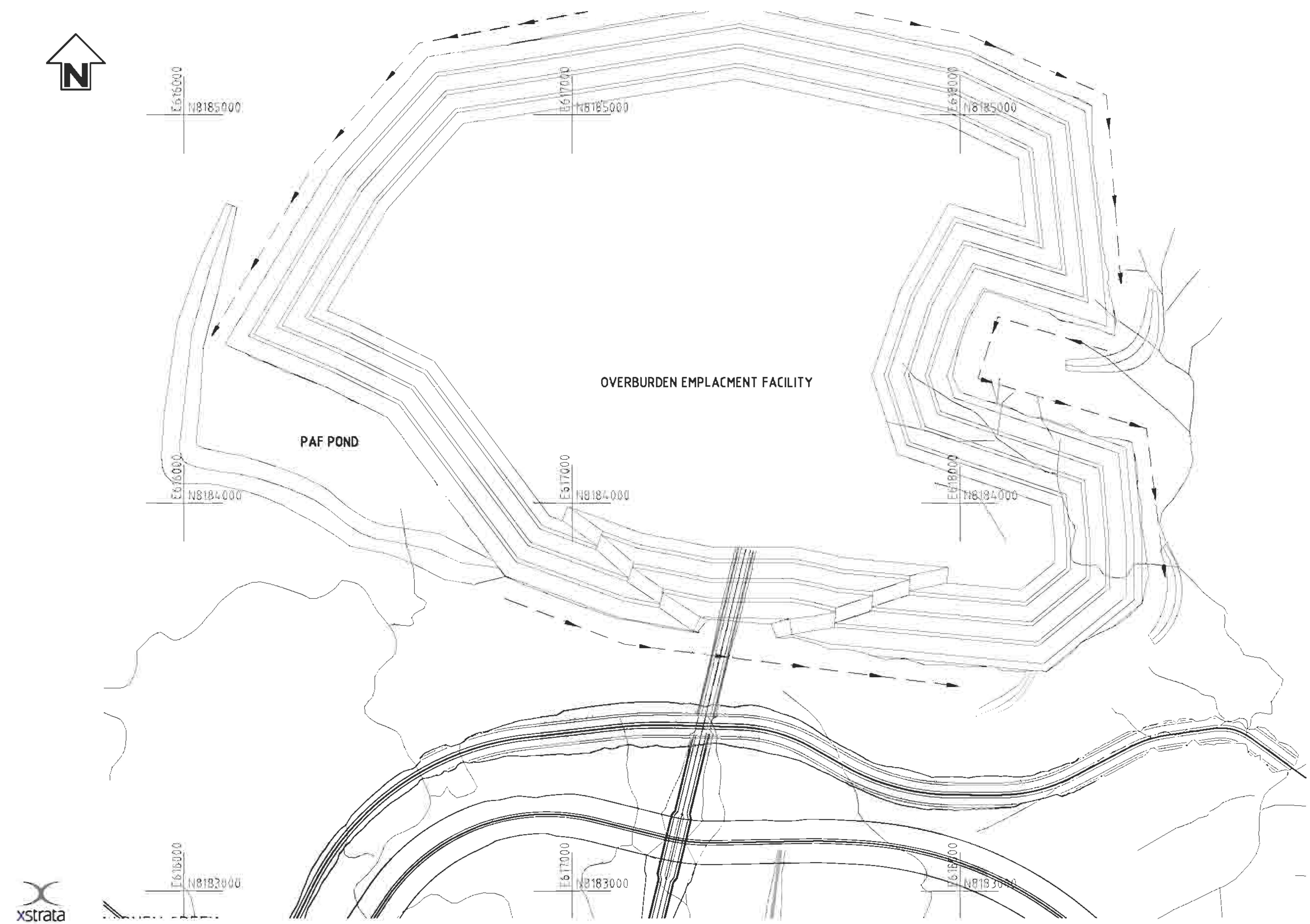
Kellogg Brown & Root Pty Ltd
KBR
Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
555 Coronation Drive, Toowong
Brisbane, Queensland, 4066
ph (07) 3721-6555 fax (07) 3721-6950

DRAWING SCALE: AS SHOWN | DRG. SIZE: A1 | PROJECT No.: BEE508

TITLE: McARTHUR RIVER MINE EXPANSION PROJECT LEVEE & DIVERSIONS LAYOUT PLAN

DRAWING No.: BEE508-C-DWG-002 | REVISION: E

DRAFTER: Y FRASER



NOTES:

1. SURVEY DATUM:
   DATUM HORIZONTAL - MRM TRUNCATED
   DATUM VERTICAL - AHD
2. ALL DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE PROJECT SPECIFICATIONS - BEE508-Z-SPEC-001 Rev 0

LAYOUT PLAN

SCALE 1:5000

NOT FOR CONSTRUCTION

100mm ON ORIGINAL DRAWING

REV	DESCRIPTION	DATE
E	HATCH & IRS CHANGES	22.08.08
D	OEF LAYOUT AMENDED	19.04.06
C	BARNEY CREEK ALIGNMENT CHANGED	21.02.06
B	[illegible] LEVEE WALL AMENDED	14.02.06
A	ISSUE FOR REVIEW	21.12.05

REVISIONS

APPROVALS	NAME	SIGNATURE
DRAFTING	S.LINK	
DESIGN	D.DUGDALE	
DESIGN VERIFICATION	D.LOVELL	
PROJECT APPROVAL	[illegible]	
CLIENT		

Kellogg Brown & Root Pty Ltd

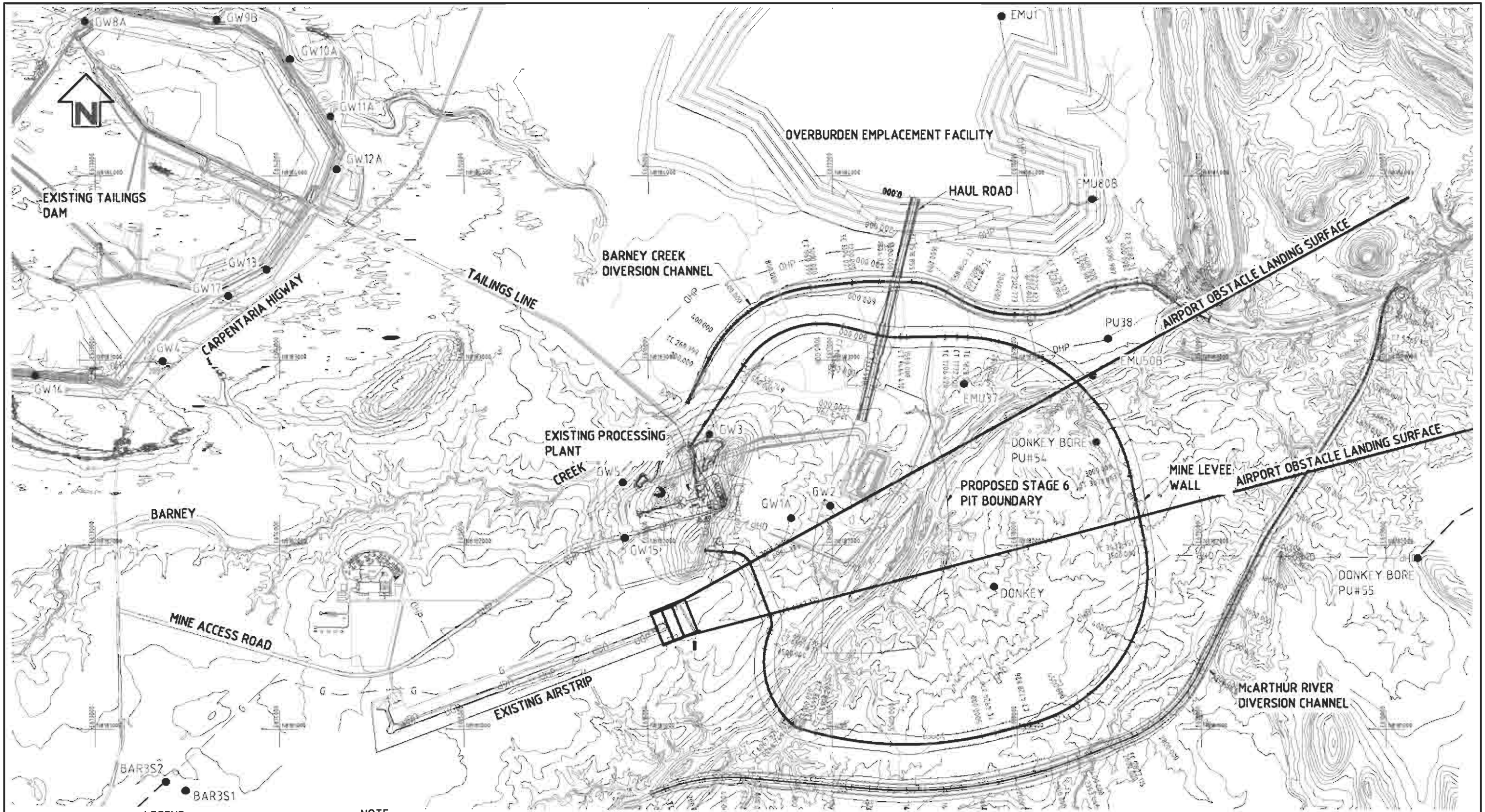
KBR

TITLE: McARTHUR RIVER MINE EXPANSION PROJECT OVERBURDEN EMPLACEMENT LAYOUT PLAN

DRAWING SCALE: AS SHOWN | DWG SIZE: A1 | PROJECT No.: BEE508

DRAFTER: T.FRASER

DRAWING No.: BEE508-C-DWG-003 | REVISION: E



LEGEND

- UGP — UNDERGROUND POWER LINE
- OHP — OVERHEAD POWER LINE
- G — GAS PIPE LINE 168ø
- ● GROUNDWATER BORE

NOTE:

1. SURVEY DATUM
   DATUM HORIZONTAL - MRM TRUNCATED
   DATUM VERTICAL - AHD
2. ALL DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE PROJECT SPECIFICATIONS - BEE508-Z-SPEC-001 Rev 0

LAYOUT PLAN

SCALE 1:10 000

NOT FOR CONSTRUCTION

xstrata

REV	DESCRIPTION	DATE
F	MATCH & LIES CHANGES	27.04.06
E	BOREHOLE LOCATION MARK ADDED TO LEGEND	21.04.06
D	OFF LAYOUT AMENDED	19.04.06
C	BARNEY CREEK ALIGNMENT CHANGED	21.03.06
B	MINE LEVEE WALL AMENDED	14.02.06
A	ISSUE FOR REVIEW	21.12.05

APPROVALS		
DRAFTING	S.LINK	
DESIGN	B.RANDALL	
DESIGN VERIFICATION	G.LOVELL	
PROJECT APPROVAL	B.MATHESS	
CLIENT		

Kellogg Brown & Root Pty Ltd

KBR

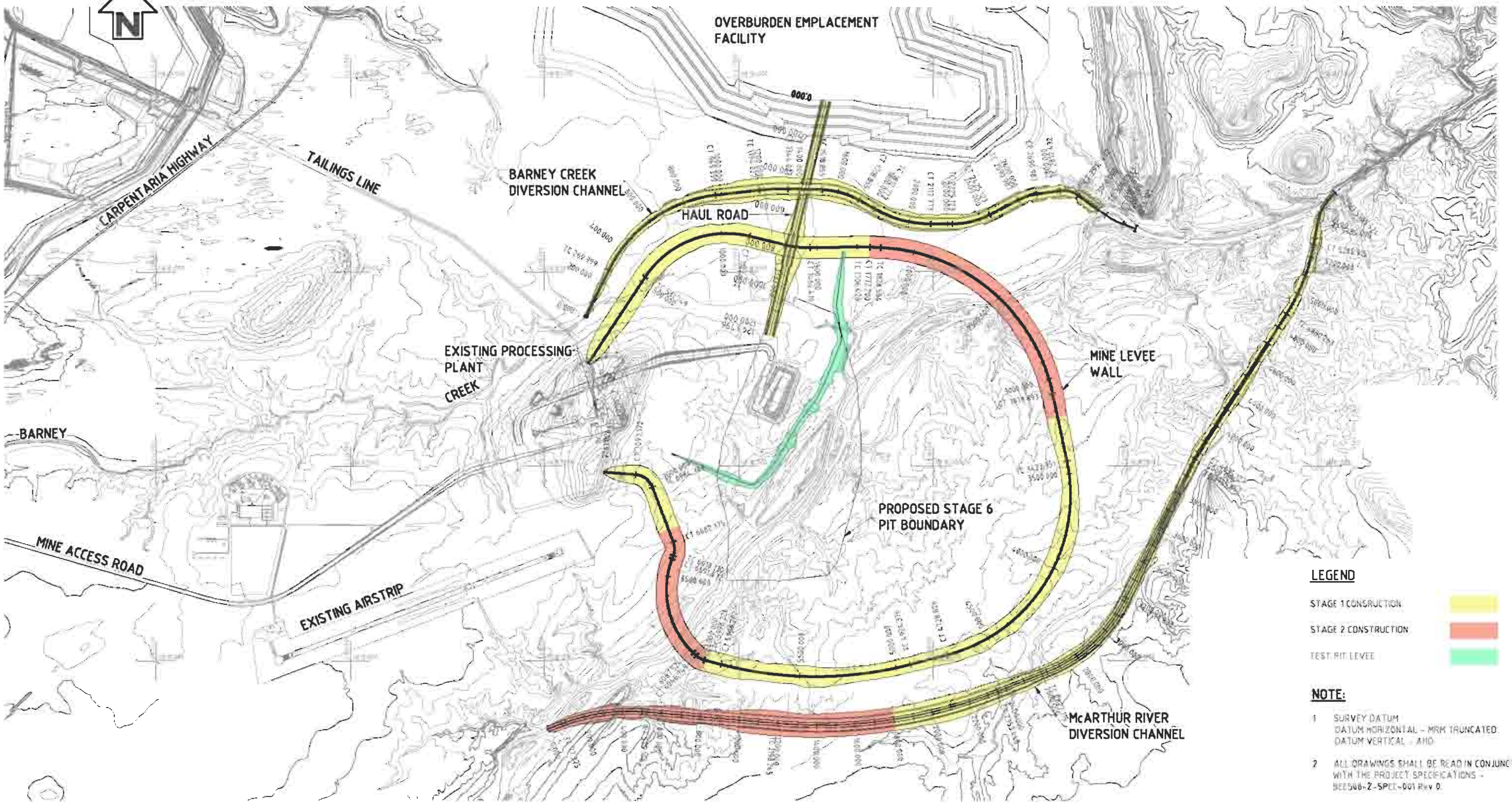
Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
555 Coronation Drive, Toowong,
Brisbane, Queensland, 4066
ph (07) 3721 6555 fax (07) 3721 6599

TITLE: McARTHUR RIVER MINE EXPANSION PROJECT SERVICES PLAN

DRAWING SCALE	DWG. SIZE	PROJECT No.	DRAWING No.	REVISION
AS SHOWN	A1	BEE508	BEE508-C-DWG-004	F

DRAFTER: T.FRASER — CAD FILE: BEE508-C-DWG-004.dwg

REFERENCE DRAWINGS — NOTES — REVISIONS — APPROVALS



LAYOUT PLAN
SCALE 1:10 000

LEGEND

- STAGE 1 CONSTRUCTION
- STAGE 2 CONSTRUCTION
- TEST PIT LEVEE

NOTE:

1. SURVEY DATUM
   DATUM HORIZONTAL - MRM TRUNCATED
   DATUM VERTICAL - AHD
2. ALL DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE PROJECT SPECIFICATIONS - BEE508-Z-SPEC-001 Rev 0.

xstrata

NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE
P	MATCH & UPS CHANGES	22.06.06
K	TEST PIT LEVEE ADDED TO LEGEND	21.06.06
J	DEP LAYOUT AMENDED	19.04.06
G	BARNEY CREEK ALIGNMENT CHANGED	21.02.06
B	MINE LEVEE WALL AMENDED	16.02.06
A	ISSUED FOR REVIEW	2.12.05

	NAME	SIGNATURE
DRAFTING	S.LINK	
DESIGN	L.LOUDDALE	
DESIGN VERIFICATION	G.A.DAVELL	
PROJECT APPROVAL	D.VERESS	
CLIENT		

Kellogg Brown & Root Pty Ltd
KBR
Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
165 Coronation Drive, Toowong,
Brisbane, Queensland, 4066
ph (07) 3221-0555 fax (07) 3721-0500

DRAWING SCALE: AS SHOWN | DRWG. SIZE: A1 | PROJECT No.: BEE508
DRAFTER: Y.FRASER | CAD FILE: BEE508-C-DWG-005.dwg

TITLE
McARTHUR RRIVER MINE
EXPANSION PROJECT
STAGE 1 CONSTRUCTION LIMITS

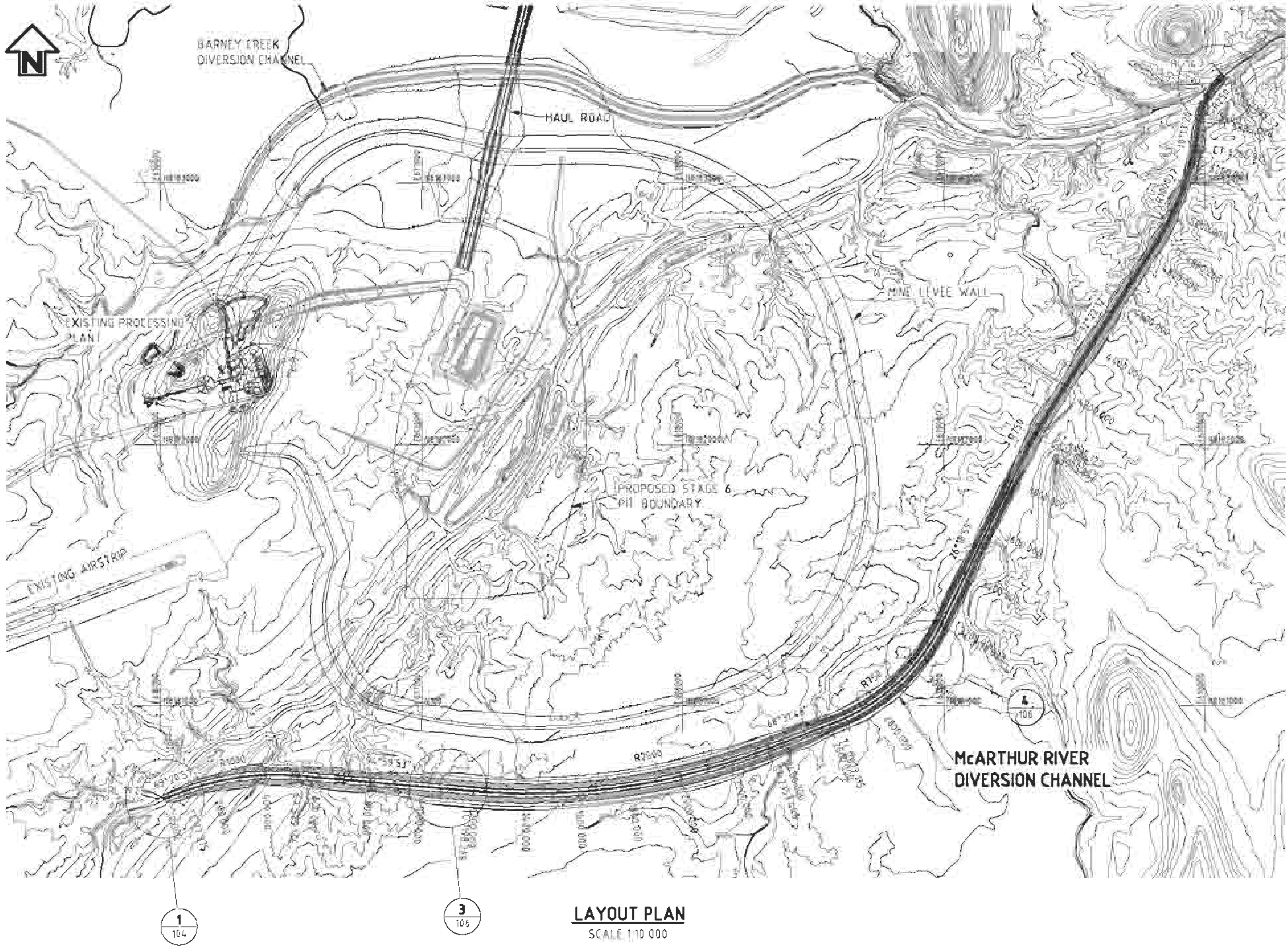
DRAWING No.: BEE508-C-DWG-005
REVISION: F

REFERENCE DRAWINGS (DRAWING No. / DESCRIPTION)

NOTES

REVISIONS

APPROVALS



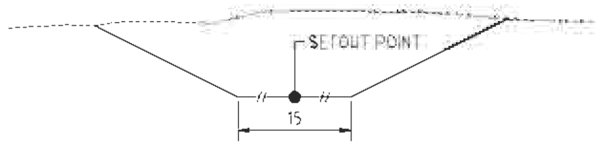
LAYOUT PLAN
SCALE 1:10 000

McARTHUR RIVER DIVERSION ALIGNMENT SETOUT

PT	CHAINAGE	EASTING	NORTHING	BEARING	RAD/SPIRAL	TANGENT	DEF ANGLE	ARC LEN
IP1	0.000	6015.489	646.244	69d20'57"				
TC	77.375	6087.893	673.532	69d20'57"				
	200.000	6204.999	709.645	76d22'24"				
IP2	301.261	6300.963	753.836		1000.255	227.701	25d38'56"	447.771
	400.000	6402.777	737.084	87d49'48"				
CT	525.146	6527.798	733.998	94d59'53"				
	600.000	6602.368	727.476	94d59'53"				
	800.000	6801.607	710.052	94d59'53"				
	1000.000	7000.847	692.627	94d59'53"				
TC	1198.765	7198.357	675.354	94d59'53"				
	1200.000	7200.085	675.204	94d57'30"				
	1400.000	7399.816	665.900	90d22'33"				
	1600.000	7599.651	672.583	85d47'36"				
IP3	1775.855	7784.208	624.119		2500.637	588.086	26d75'05"	1155.182
	1800.000	7798.314	695.210	81d12'39"				
	2000.000	7994.533	733.637	76d37'42"				
	2200.000	8187.055	787.618	72d02'45"				
CT	2353.446	8331.487	839.367	68d31'48"				
	2400.000	8374.810	856.406	68d31'48"				
	2600.000	8560.932	929.609	68d31'48"				
TC	2627.115	8586.165	939.533	68d31'48"				
	2800.000	8738.374	1020.110	55d19'33"				
IP4	2903.474	8855.649	1045.523		750.191	289.578	42d12'49"	552.718
	3000.000	8885.836	1154.944	40d03'03"				
CT	3179.833	8984.027	1309.089	26d18'59"				
	3200.000	8992.947	1323.167	26d18'59"				
	3400.000	9081.632	1502.439	26d18'59"				
	3600.000	9170.298	1681.711	26d18'59"				
	3800.000	9258.963	1860.983	26d18'59"				
TC	3955.862	9328.060	2000.692	26d18'59"				
IP5	3995.493	9345.647	2036.250		750.191	39.67	6d03'14"	79.265
	4000.000	9348.780	2039.857	29d41'14"				
CT	4035.127	9366.885	2069.755	32d22'12"				
	4200.000	9455.156	2209.008	32d22'12"				
	4400.000	9567.233	2377.929	32d22'12"				
	4600.000	9669.311	2546.851	32d22'12"				
	4800.000	9776.388	2715.772	32d22'12"				
TC	4880.263	9819.360	2783.563	32d22'12"				
	5000.000	9877.266	2888.284	25d30'41"				
IP6	5073.589	9924.172	2948.811		1000.255	195.77	22d08'52"	386.651
	5200.000	9944.847	3076.167	14d03'19"				
CT	5266.915	9958.915	3141.573	10d13'20"				
TC	5385.476	9979.966	3258.252	10d13'20"				
	5400.000	9982.946	3272.463	13d33'04"				
IP8	5457.076	9996.574	3350.411	30d45'24"	250.000	93.642	41d06'89"	179.196
CT	5565.524	10070.312	3409.501	51d29'11"				

NOTES:

1. SURVEY DATUM
   DATUM HORIZONTAL - MRM TRUNCATED
   DATUM VERTICAL - AHD
2. ALL DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE PROJECT SPECIFICATIONS - BEE508-Z-SPEC-001
3. ROCK RIFFLES TO BE LOCATED AT CHAINAGES 300, 1400, 2300, 3075, 3700, 4650.
4. FOR DETAILS OF ROCK RIFFLES REFER TO DWG-105.



SETOUT SECTION DETAIL
NTS

xstrata

NOT FOR CONSTRUCTION

© Kellogg Brown & Root Pty Ltd

100mm ON ORIGINAL DRAWING

SCALE 1:10000

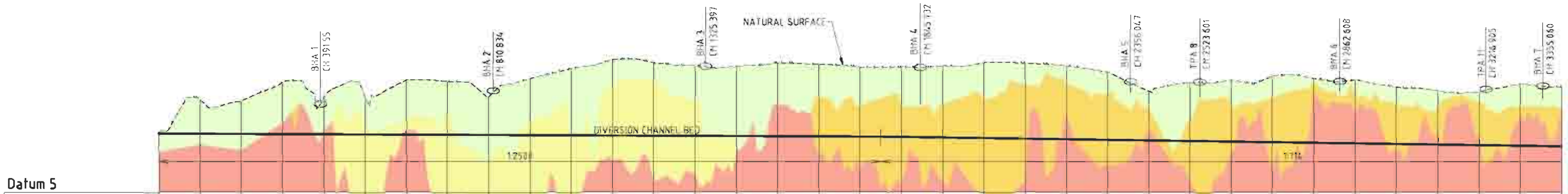
REV	DESCRIPTION	DATE
H	HATCH CHANGES	30.05.06
G	HATCH & URS CHANGES	22.06.06
F	HATCH CHANGES	28.05.06
E	HATCH & URS CHANGES	04.05.06
D	HATCH & URS MARKUPS	04.04.06
C	BARNEY CREEK ALIGNMENT CHANGED	21.02.06
B	MINE LEVEE WALL AMENDED	16.02.06
A	ISSUE FOR REVIEW	21.11.05

	NAME	SIGNATURE
DRAFTING	S.LINK	
DESIGN	G.DUGDALE	
DESIGN VERIFICATION	G.LOVELL	
PROJECT APPROVAL	D.VERESS	
CLIENT		

Kellogg Brown & Root Pty Ltd
KBR
Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
555 Coronation Drive, Toowong
Brisbane, Queensland, 4066
ph (07) 3721-6555 fax (07) 3721-6500

TITLE: McARTHUR RIVER MINE EXPANSION PROJECT McARTHUR RIVER DIVERSION SETOUT DETAILS

DRAWING SCALE: AS SHOWN | DRG. SIZE: A1 | PROJECT No.: BEE508
DRAWING No.: BEE508-C-DWG-101 | REVISION: H
DRAFTER: Y FRASER | CAD FILE: BEE508-C-DWG-101.DWG



Datum 5

CHANNEL BED ELEVATION	19.200	19.160	19.120	19.080	19.040	19.000	18.960	18.920	18.880	18.840	18.800	18.760
NATURAL SURFACE	19.662	27.468	27.111	31.696	28.161	27.897	32.191	31.854	28.077	32.530	34.903	37.105
EXCAVATION DEPTH	0.462	8.308	7.991	12.616	9.121	8.897	13.231	12.934	9.197	13.690	16.103	18.345
CHAINAGE	0.000	100.000	200.000	300.000	400.000	500.000	600.000	700.000	800.000	900.000	1000.000	1100.000
CROSS SECTION TYPE	TYPE A1									T	TYPE B1	

CHANNEL BED ELEVATION	18.720	18.680	18.640	18.600	18.560	18.520	18.430	18.290	18.150	18.010	17.870	17.730
NATURAL SURFACE	36.361	35.610	35.550	36.342	36.006	35.380	35.308	35.624	36.352	36.278	35.614	34.058
EXCAVATION DEPTH	17.641	16.930	16.910	17.742	17.446	16.860	16.878	17.334	18.202	18.268	17.744	16.328
CHAINAGE	1200.000	1300.000	1400.000	1500.000	1600.000	1700.000	1800.000	1900.000	2000.000	2100.000	2200.000	2300.000
CROSS SECTION TYPE				TYPE B2								

CHANNEL BED ELEVATION	17.590	17.450	17.310	17.170	17.030	16.890	16.750	16.610	16.470	16.330	16.190
NATURAL SURFACE	29.485	31.523	32.110	33.118	32.539	32.188	30.458	29.565	29.233	31.211	30.418
EXCAVATION DEPTH	11.895	14.077	14.800	15.948	15.509	15.298	13.708	12.955	12.763	14.881	14.228
CHAINAGE	2400.000	2500.000	2600.000	2700.000	2800.000	2900.000	3000.000	3100.000	3200.000	3300.000	3400.000
CROSS SECTION TYPE		T	TYPE C								

NOTE
BHA - BOREHOLE LOCATIONS
T= TRANSITION (REFER TABLE ON THIS DWG)

McARTHUR RIVER DIVERSION CHANNEL

SCALE HORIZ 1:5 000 VERT 1:500

Datum 5

CHANNEL BED ELEVATION	16.190	16.050	15.910	15.770	15.630	15.490	15.300	15.260	15.220	15.180	15.140
NATURAL SURFACE	30.418	26.716	26.785	25.348	25.295	25.582	24.733	24.784	24.844	25.051	27.933
EXCAVATION DEPTH	14.228	10.666	10.875	9.578	9.665	10.092	9.433	9.524	9.624	9.871	12.793
CHAINAGE	3400.000	3500.000	3600.000	3700.000	3800.000	3900.000	4000.000	4100.000	4200.000	4300.000	4400.000
CROSS SECTION TYPE	TYPE C				T	TYPE A1			TYPE A2		

CHANNEL BED ELEVATION	15.100	15.060	15.020	14.980	14.940	14.900	14.860	14.820	14.779	14.737	14.700
NATURAL SURFACE	26.383	23.204	23.163	23.555	24.000	20.285	19.730	19.374	26.893	21.214	16.034
EXCAVATION DEPTH	11.283	8.144	8.143	8.575	9.060	5.385	4.870	4.554	12.113	6.477	1.334
CHAINAGE	4500.000	4600.000	4700.000	4800.000	4900.000	5000.000	5100.000	5200.000	5300.000	5400.000	5487.832
CROSS SECTION TYPE											

McARTHUR RIVER DIVERSION CHANNEL

SCALE HORIZ 1:5 000 VERT 1:500

McARTHUR RIVER DIVERSION CHANNEL MATERIAL LEGEND

🟩	CLAY, SILTY CLAY, SANDY CLAY
🟨	SAND, SILTY SAND, CLAYEY SAND
🟧	WEATHERED (SOFT) ROCK
🟥	FRESH (HARD) ROCK

McARTHUR RIVER DIVERSION CHANNEL

CHAINAGE (m)	CHANNEL TYPE	BED WIDTH(m)
0 to 900	TYPE A1	28
900 TO 1000	TYPE A1 TO TYPE B1	28
1000 TO 1100	TYPE B1	28 TO 27
1100 TO 1400	TYPE B1	27
1400 TO 1500	TYPE B1	27 TO 25
1500 TO 2100	TYPE B2	25
2100 TO 2200	TYPE B2	25 TO 23
2200 TO 2500	TYPE B2	23
2500 TO 2600	TYPE B2 TO TYPE C	23 TO 25
2600 TO 3300	TYPE C	25
3300 TO 3400	TYPE C	25 TO 20
3400 TO 3800	TYPE C	20
3800 TO 3900	TYPE C TO TYPE A1	20 TO 15
3900 TO 4200	TYPE A1	15
4200 TO 5487	TYPE A2	15

xstrata

XREFS

NOT FOR CONSTRUCTION

DRAWING No.	DESCRIPTION

REFERENCE DRAWINGS

100mm ON ORIGINAL DRAWING

NOTES

REV	DESCRIPTION	DATE
D	HATCH CHANGES AND COLOUR ADDED	25.05.06
C	HATCH & URS CHANGES	04.05.06
B	TRANSITIONS TABLE ADDED	04.04.06
A	ISSUE FOR REVIEW	21.12.05

REVISIONS

	NAME	SIGNATURE
DRAFTING	S.LINK	
DESIGN	G.DUGDALE	
DESIGN VERIFICATION	G.LOVELL	
PROJECT APPROVAL	D.VENESS	
CLIENT		

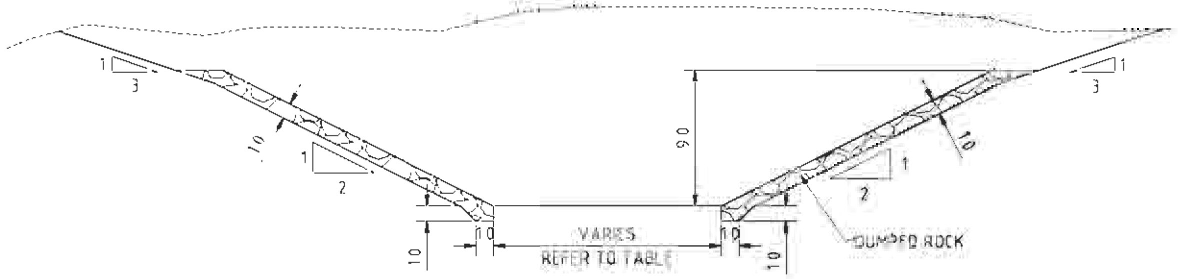
APPROVALS

Kellogg Brown & Root Pty Ltd
KBR
Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
[illegible] Coronation Drive, Toowong,
Brisbane, Queensland, [illegible]
ph (07) 3721-6555 fax (07) 3721-6500

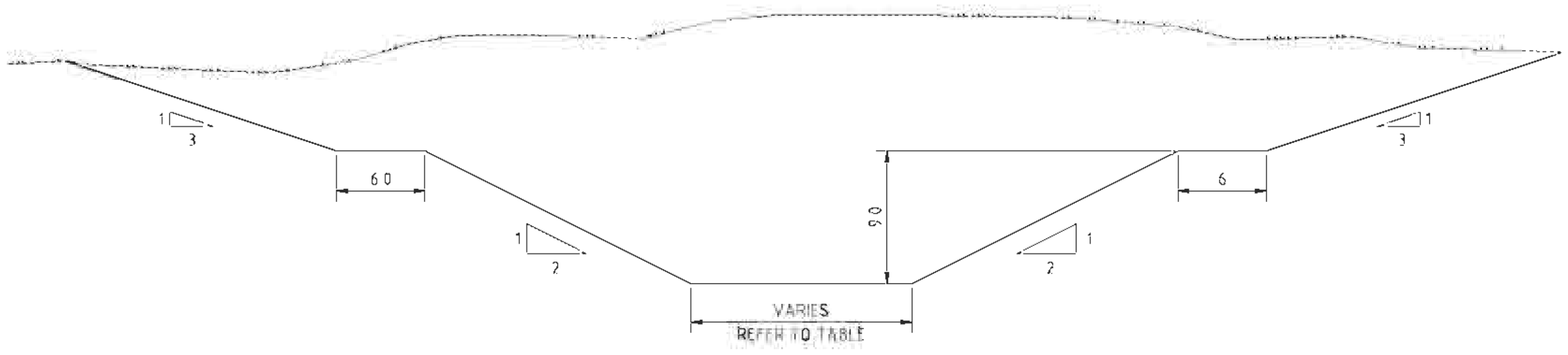
DRAWING SCALE AS SHOWN
ORIG. SIZE A1
PROJECT No. BEE508
DRAFTER Y.FRASER
CAD FILE BEE508-C-DWG-102.DWG

TITLE
McARTHUR RIVER MINE
EXPANSION PROJECT
MCARTHUR RIVER DIVERSION
LONGITUDINAL SECTIONS

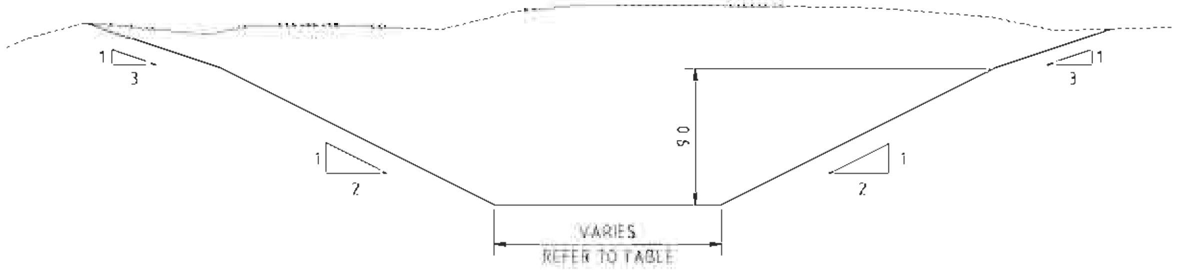
DRAWING No. BEE508-C-DWG-102
REVISION D



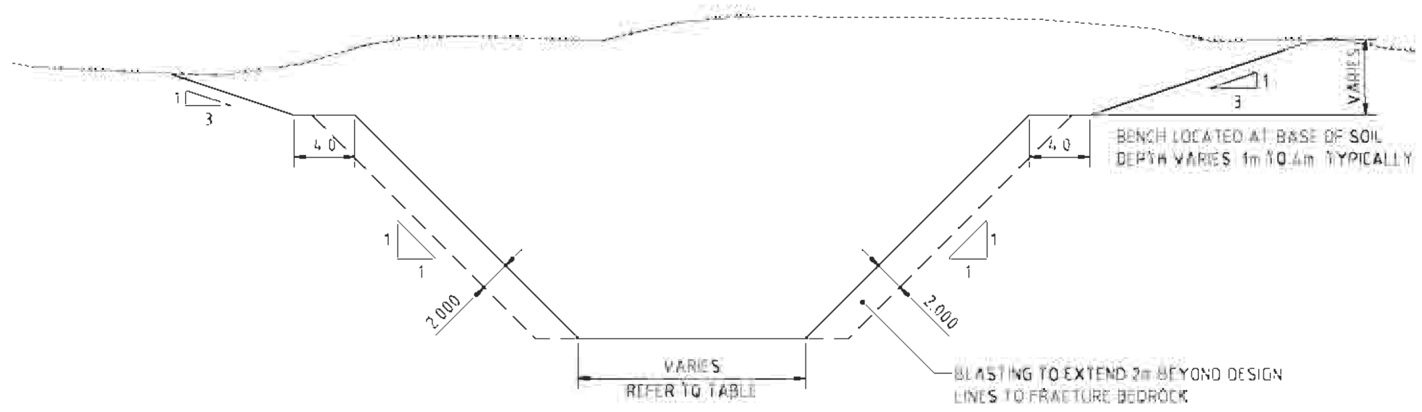
McARTHUR RIVER DIVERSION CHANNEL
TYPE A1
SCALE 1:250



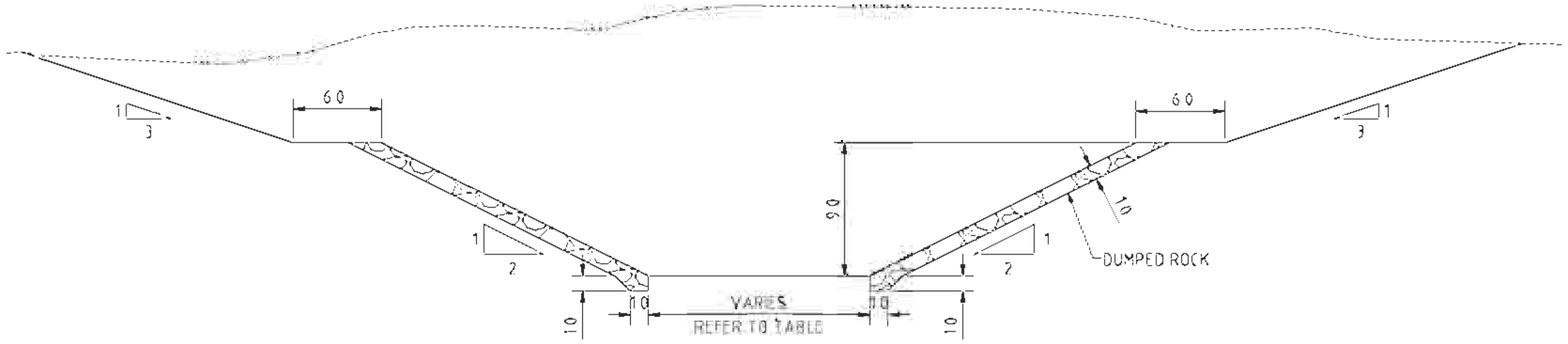
McARTHUR RIVER DIVERSION CHANNEL
TYPE B2
SCALE 1:250



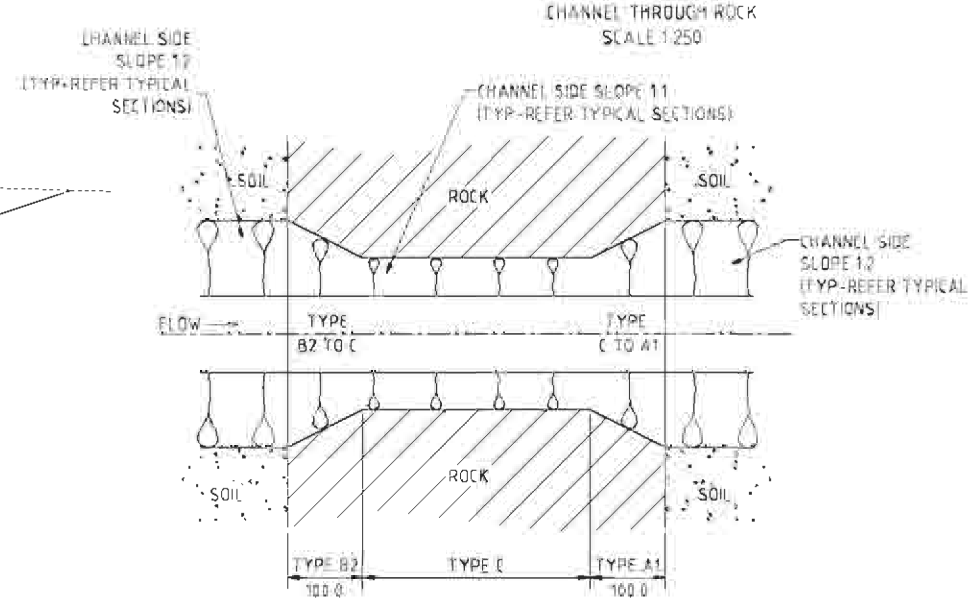
McARTHUR RIVER DIVERSION CHANNEL
TYPE A2
SCALE 1:250



McARTHUR RIVER DIVERSION CHANNEL
TYPE C
CHANNEL THROUGH ROCK
SCALE 1:250



McARTHUR RIVER DIVERSION CHANNEL
TYPE B1
SCALE 1:250



DIVERSION CHANNEL
TRANSITION DETAIL

NOTES:

1. DUMPED ROCK TO COMPRISE FRESH ANGULAR DURABLE "RUN OF EXCAVATION ROCK" WITH A MAXIMUM BLOCK SIZE OF 700mm AND NO MORE THAN 20% BY MASS LESS THAN 200mm BLOCK SIZE.
2. TOPSOIL TO BE SPREAD OVER DUMPED ROCK AND SLUICED INTO ROCK VOIDS
3. REVEGETATION BY OTHERS IN ACCORDANCE WITH MRM "REHABILITATION PLAN"

xstrata

NOT FOR CONSTRUCTION

 XREFS

DRAWING No.	DESCRIPTION
REFERENCE DRAWINGS	

100mm ON ORIGINAL DRAWING
SCALE 1:250
NOTES

REV	DESCRIPTION	DATE
E	HATCH & URS CHANGES	16.06.06
D	HATCH & URS CHANGES	04.05.06
C	HATCH & URS NOTES ADDED	06.04.06
B	TYPICAL SECTIONS AMENDED AND NOTE ADDED	01.03.06
A	ISSUE FOR REVIEW	21.12.05

REVISIONS

	NAME	SIGNATURE
DRAFTING	S.LOW	
DESIGN	G.DUGDALE	
DESIGN VERIFICATION	S.LEVELL	
PROJECT APPROVAL	D.VENESS	
CLIENT		

APPROVALS

Kellogg Brown & Root Pty Ltd
KBR
Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
555 Coronation Drive, Toowong, Brisbane, Queensland, 4066
ph (07) 3721-6555 fax (07) 3721-6500

DRAWING SCALE	DWG. SIZE	PROJECT No.
AS SHOWN	A1	BEE508

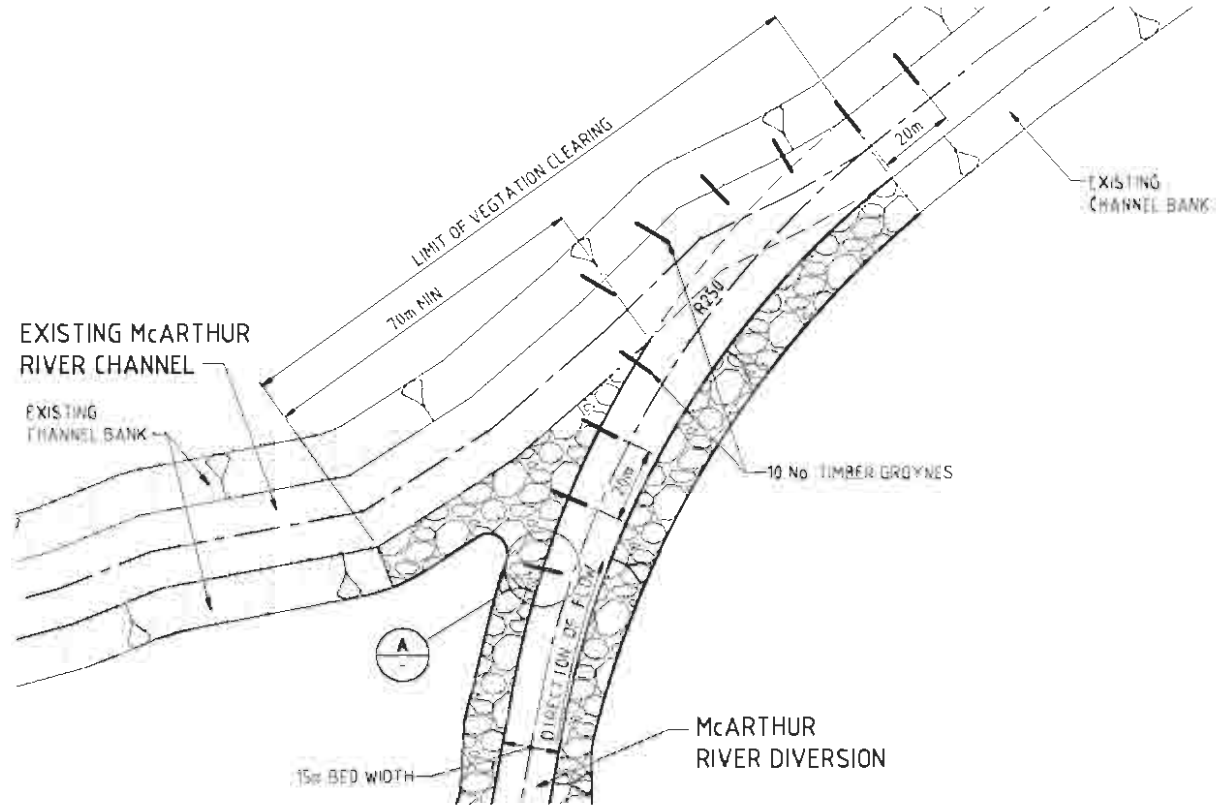
TITLE
McARTHUR RIVER MINE
EXPANSION PROJECT
McARTHUR RIVER DIVERSION
TYPICAL SECTIONS

DRAWING No. BEE508-C-DWG-103
REVISION E

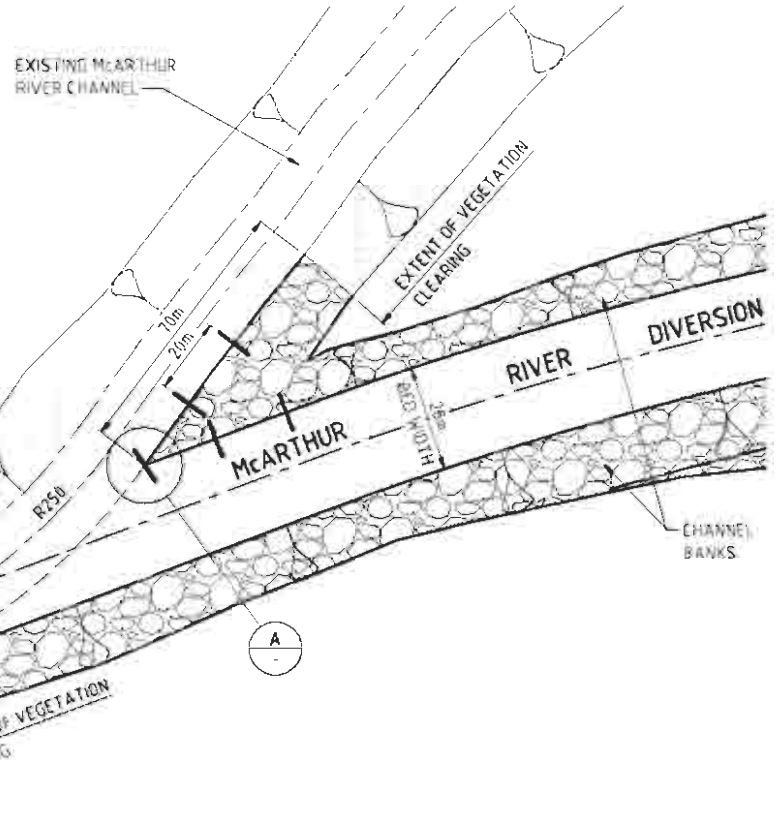
LEGEND

DUMPED ROCK BANK PROTECTION (REFER BEE508-C-DWG-103)

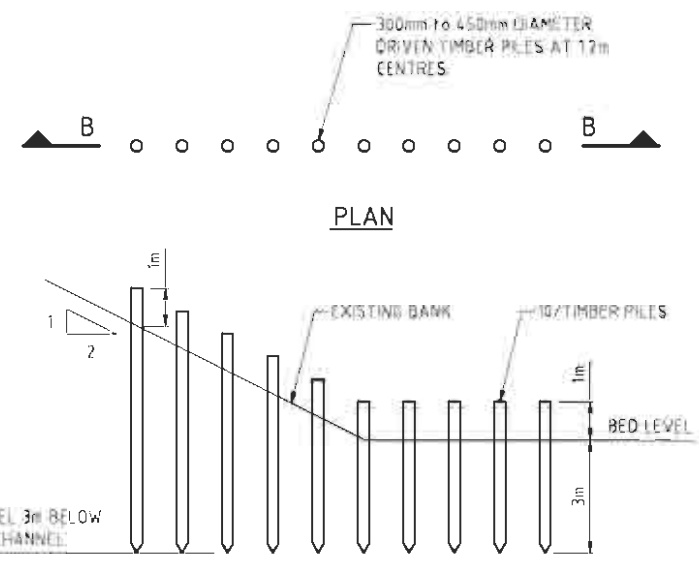
UNDISTURBED RIVER BANK



DOWNSTREAM OUTLET BANK PROTECTION DETAIL (2/101)
SCALE 1:1000



UPSTREAM INLET BANK PROTECTION DETAIL (1/101)
SCALE 1:1000



SECTION B-B

TIMBER GROYNES DETAIL (A/104)
SCALE 1:200

xstrata

NOTE: THIS DRAWING HAS BEEN COMPILED FROM SKETCHES PROVIDED BY CONNELL HATCH

NOT FOR CONSTRUCTION

DRAWING No.	DESIGN PACK
REFERENCE DRAWINGS	

100mm (IN ORIGINAL DRAWING)

NOT TO SCALE

NOTES

REV	DESCRIPTION	DATE
F	MATCH CHANGES	28.05.08
E	DRAWING COMPILED FROM MATCH SKETCHES NOTE ADDED	17.03.08
D	MATCH & URS CHANGES	04.05.08
C	MATCH & URS CHANGES	01.04.08
B	ROCK VOLUME ADDED	31.07.07
A	ISSUE FOR REVIEW	27.07.07

REVISIONS

	NAME	SIGNATURE
DRAFTING	S.LINK	
DESIGN	C.LOGGDALE	
DESIGN VERIFICATION	G.LOVELL	
PROJECT APPROVAL	G.WITTEN	
CLIENT		

APPROVALS

Kellogg Brown & Root Pty Ltd

KBR

Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
548 Coronation Drive, Toowong
Brisbane Queensland 4066
ph (07) 3721-6555 fax (07) 3120-6500

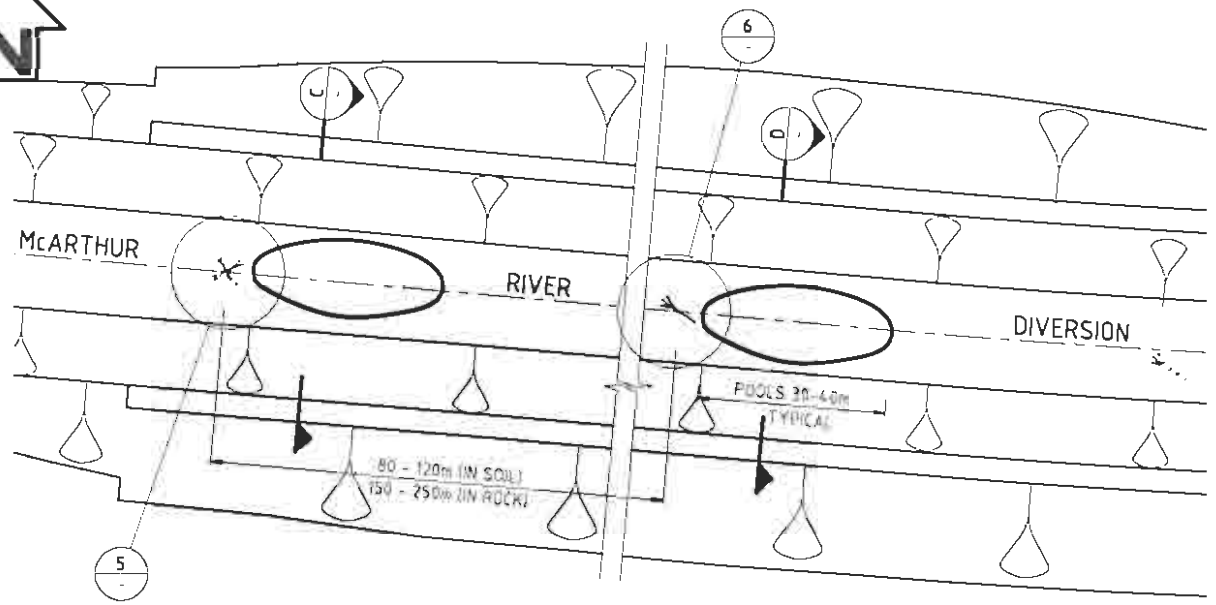
TITLE
McARTHUR RIVER MINE
EXPANSION PROJECT
MCARTHUR RIVER DIVERSION
TYPICAL DETAILS - INLET/OUTLET

DRAWING SCALE	DWG SIZE	PROJECT No.
AS SHOWN	A1	BEE508

DRAWING No. BEE508-C-DWG-104

REVISION F

DRAFTER C.RITSON CAD FILE BEE508-C-DWG-104.dwg



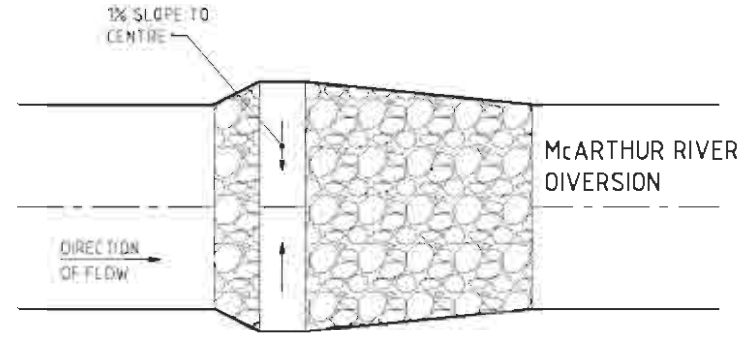
LARGE WOODY DEBRIS DISTRIBUTED RANDOMLY ALONG AND ACCROSS CHANNEL FLOOR

FISH HABITAT TREATMENT

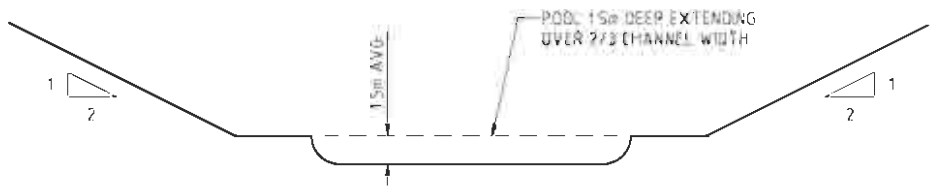
DETAIL 3 / 101
SCALE 1:1000

DETAIL 4 / 101
SCALE 1:1000

SECTION
ROCK RIFFLE
SCALE 1:200

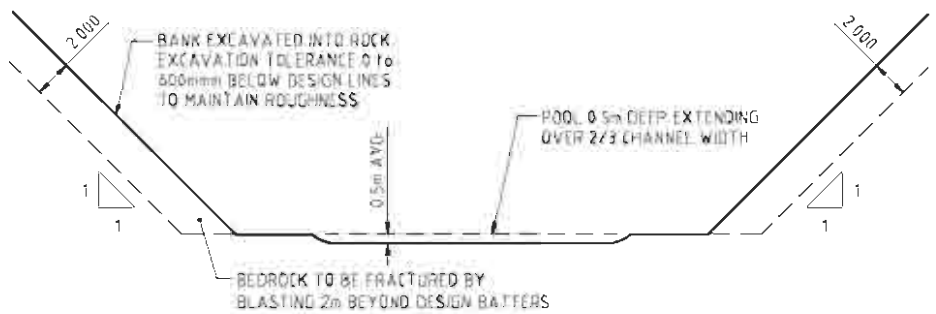


PLAN
ROCK RIFFLE
SCALE 1:500



POOL DETAILS IN CHANNEL TYPES A1, A2, B1 & B2

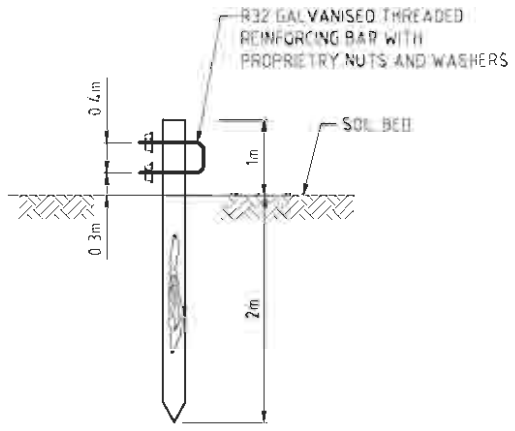
SECTION C / -
SCALE 1:200



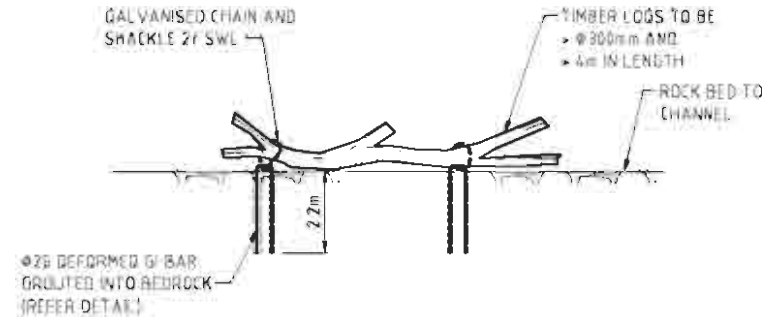
POOL DETAILS IN CHANNEL TYPE C

SECTION D / -
SCALE 1:200

FOR McARTHUR RIVER CHANNEL TYPES REFER TO BEE508-C-DWG-103

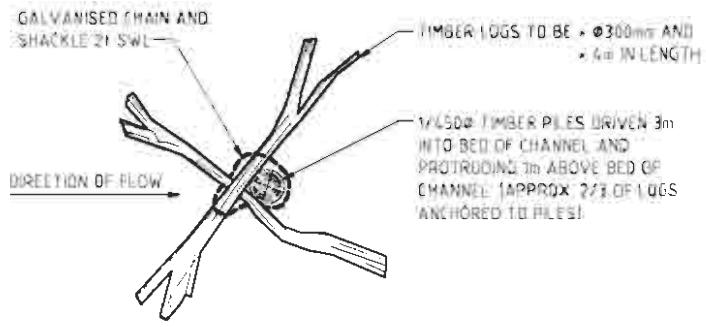


LARGE WOODY DEBRIS TIMBER PILE DETAIL
(N.T.S.)



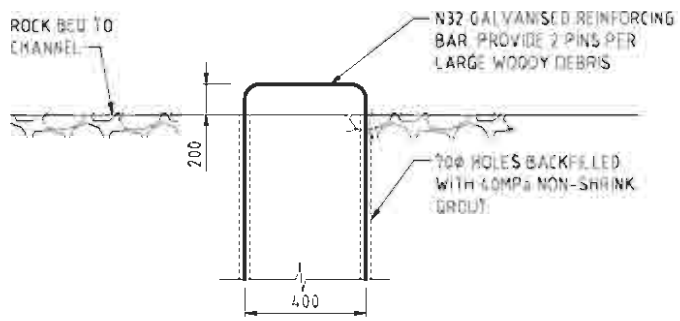
LARGE WOODY DEBRIS - LOCATED ON ROCK CHANNEL BED

SECTION 6 / -
SCALE 1:100



LARGE WOODY DEBRIS - LOCATED ON SOIL CHANNEL BED

DETAIL 5 / -
SCALE 1:100



G.I. BAR DETAIL
(N.T.S.)

xstrata

NOTE: THIS DRAWING HAS BEEN COMPILED FROM SKETCHES PROVIDED BY CONNELL HATCH

NOT FOR CONSTRUCTION

DRAWING No.	DESCRIPTION
REFERENCE DRAWINGS	

100mm ON ORIGINAL DRAWING
SCALE 1:100 SCALE 1:500
SCALE 1:200 SCALE 1:1000

NOTES

REV	DESCRIPTION	DATE
D	WATER & HPS CHANNEL DWG 106 CHANGED TO 105	16.06.05
C	MATCH CHANGES	23.05.05
B	PLANNING POOL VOLUME NOTES ADDED	21.02.05
A	ISSUE FOR REVIEW	21.12.04

REVISIONS

	NAME	SIGNATURE
DRAFTING	S.LINK	
DESIGN	C.LOUGHRIDGE	
DESIGN VERIFICATION	G.LOVELL	
PROJECT APPROVAL	G.WATTS	
CLIENT		

APPROVALS

Kellogg Brown & Root Pty Ltd
KBR
Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
300 Coronation Drive, Fairfield
Brisbane Queensland 4066
ph (07) 3721-6555 fax (07) 3721-6500

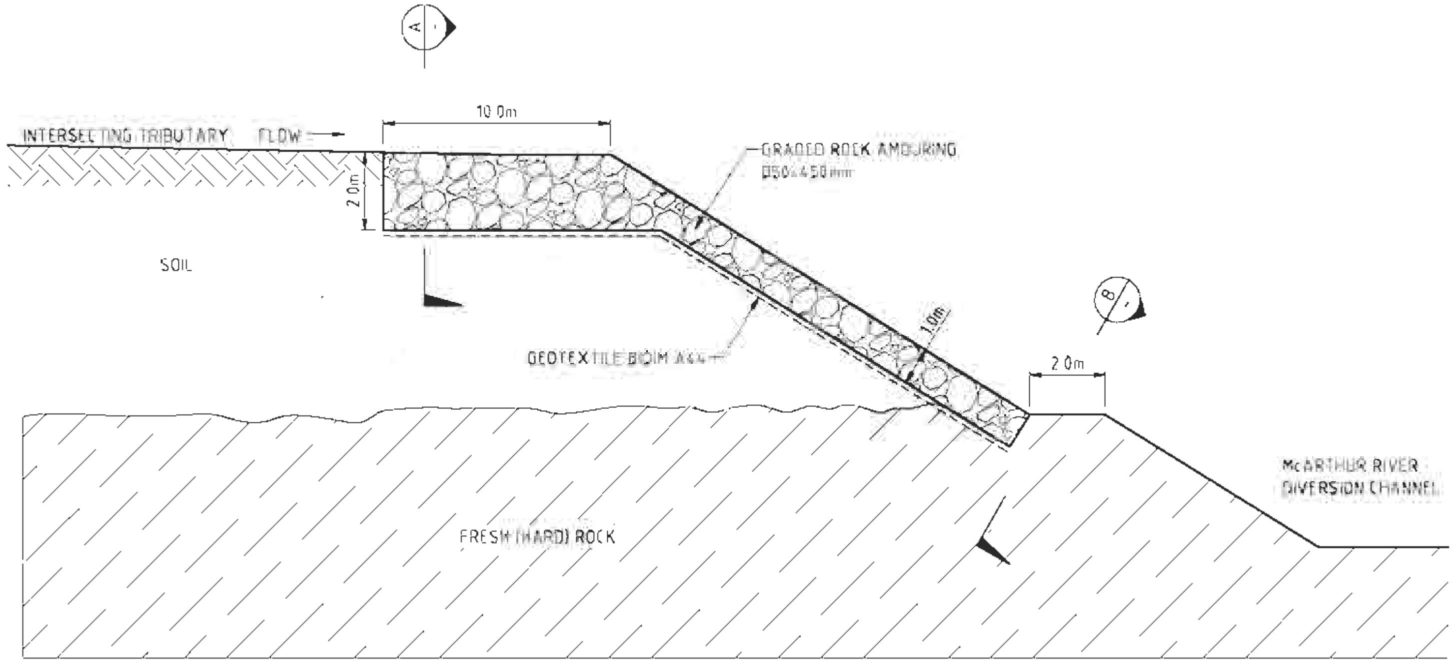
DRAWING SCALE	DWG SIZE	PROJECT No.
AS SHOWN	A1	BEE508

DRAFTER: C.WATSON CAD FILE: BEE508-C-DWG-105.dwg

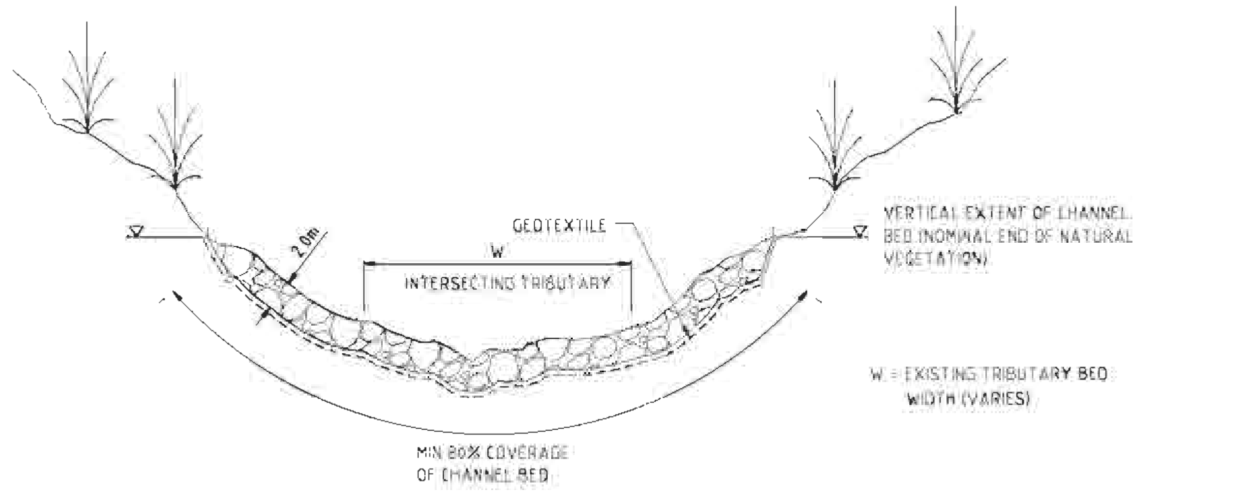
TITLE
McARTHUR RIVER MINE
EXPANSION PROJECT
McARTHUR RIVER DIVERSION
TYPICAL BED DETAILS

DRAWING No. **BEE508-C-DWG-105**

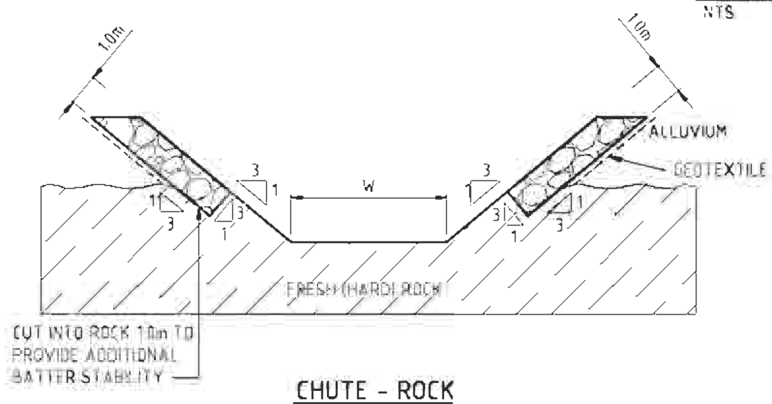
REVISION **D**



TYPICAL SECTION IN SOIL & ROCK
N.T.S

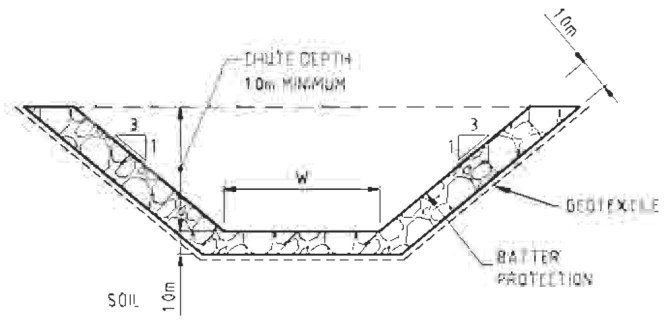


SECTION A
NTS



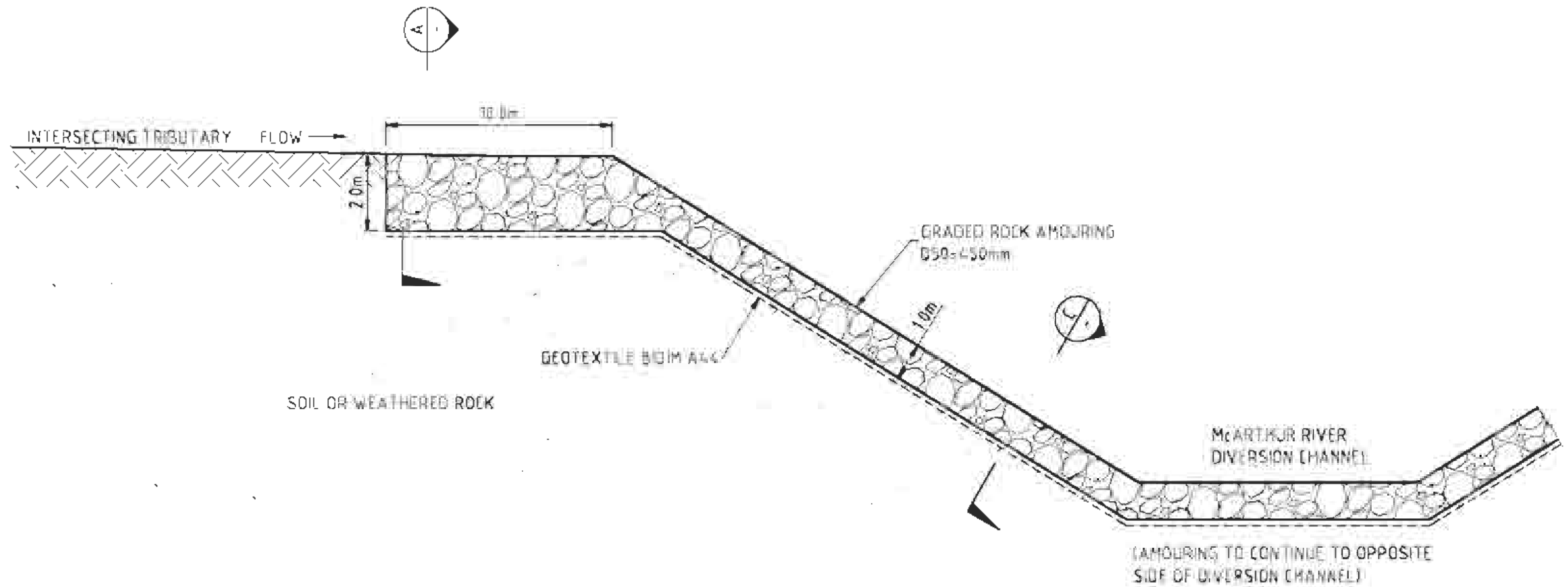
CHUTE - ROCK

SECTION B
NTS



CHUTE - SOIL

SECTION C
NTS



TYPICAL SECTION IN SOIL
N.T.S

ADDITIONAL REQUIREMENTS

1) PROFILING BACK TO THE EXISTING TOPOGRAPHY/TRIBUTARY BED SHOULD BE DONE IN SUCH A MANNER AS TO AVOID RAPID EXPANSION IN CROSS-SECTION AREA

2) THE ENTIRE STRUCTURE SHALL BE CONSTRUCTED SUCH THAT THERE WILL BE NO CONCENTRATION OF FLOW AT ANY POINT. THIS MEANS THAT IT MUST BE LEVEL ACROSS ITS WIDTH FOR THE ENTIRE DISTURBED AREA (EXCEPT BATTERS)

3) WHERE FRESH (HARD) ROCK IS ENCOUNTERED ALONG THE CHUTE, IT MUST BE PRESENT ACROSS THE WHOLE WIDTH BEFORE ANY TRANSITION IN SLOPE MAY OCCUR

4) ANY SMALL NATURAL DRAINS THAT ENTER THE CHUTE (E.G. VIA BATTERS) WILL BE TREATED BY PLACING ROCK ARMOURING AS PER INTERSECTING TRIBUTARY DETAILS

5) GRADING OF ROCK ARMOURING

1.5-2.0 x D50	100%
D50	50%
0.3-0.4 D50	10-20%

ROCK SIZE (mm)	% PASSING BY WEIGHT
700	100
450	40 - 60
200	< 20

ROCK PROTECTION GENERAL
- 25 MPa GREATER THAN OR EQUAL TO ROCK CRUSHING STRENGTH
- LENGTH < 2.5m WIDTH OR THICKNESS
- ANGULAR IN SHAPE
- FREE OF DIFFUSED CLEAVAGE PLANES
- NOT ADVERSELY AFFECTED BY REPEATED WETTING AND DRYING

6) GEOTEXTILE - BIDIM A44 OR APPROVED EQUIVALENT

xstrata

NOT FOR CONSTRUCTION

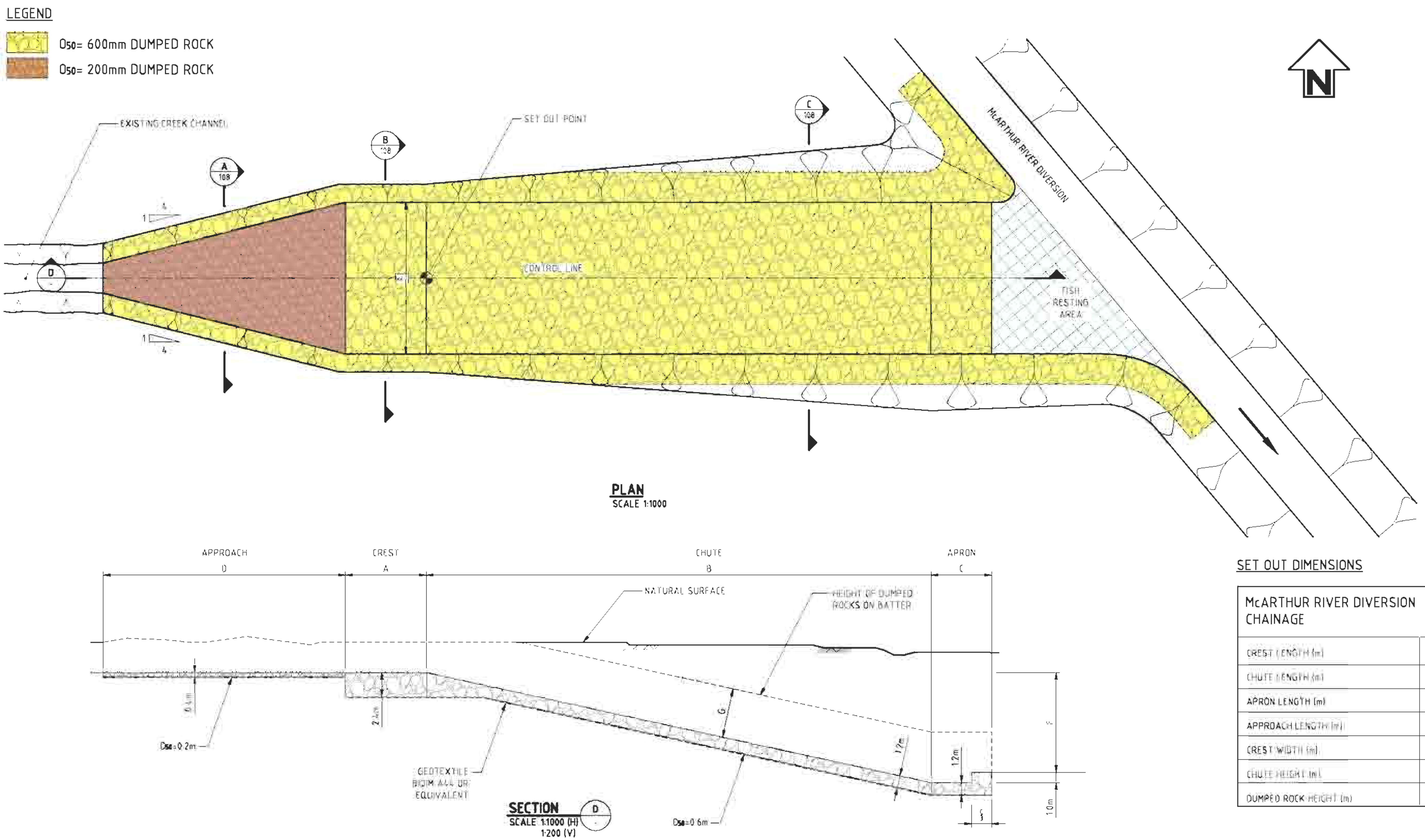
NOT TO SCALE

REV	DESCRIPTION
D	BATCH & URS CHANGES. DWG 105 CHANGED TO 106
C	BATCH CHANGES
B	BATCH & URS CHANGES
A	ISSUE FOR REVIEW

	NAME
DRAFTING	S.LINK
DESIGN	C.GOODALE
DESIGN VERIFICATION	G.LOVELL
PROJECT APPROVAL	G.WATTERS
CLIENT	

Kellogg Brown & Root Pty Ltd
KBR

DRAWING SCALE	AS SHOWN
DWG SIZE	A1
PROJECT No.	BEE508
DRAFTER	J.FRASER
TITLE	McARTHUR RIVER MINE EXPANSION PROJECT McARTHUR RIVER DIVERSION TYPICAL DETAILS - TRIBUTARY TREATMENT DETAILS
DRAWING No.	BEE508-C-DWG-106
REVISION	D



SET OUT DIMENSIONS

McARTHUR RIVER DIVERSION CHAINAGE		CH. 3250	CH. 4420
CREST LENGTH (m)	A	40	20
CHUTE LENGTH (m)	B	250	90
APRON LENGTH (m)	C	30	15
APPROACH LENGTH (m)	D	120	20
CREST WIDTH (m)	E	75	10
CHUTE HEIGHT (m)	F	10.9	7.4
DUMPED ROCK HEIGHT (m)	G	5	3

NOTES:

1. PROFILING BACK TO EXISTING CHANNEL AND BANKS SHOULD BE DONE IN SUCH A MANNER AS TO AVOID RAPID EXPANSION IN CROSS-SECTIONAL AREA.
2. DUMPED ROCK PROTECTION MAY BE OMITTED WHEN FRESH ROCK IS PRESENT OVER FULL WIDTH OF STRUCTURE.
3. FOR DETAILS OF DUMPED ROCK PROTECTION AND GEOTEXTILE REFER TO SPECIFICATION.

NOTE: THIS DRAWING HAS BEEN COMPILED FROM SKETCHES PROVIDED BY CONNELL HATCH

NOT FOR CONSTRUCTION

xstrata

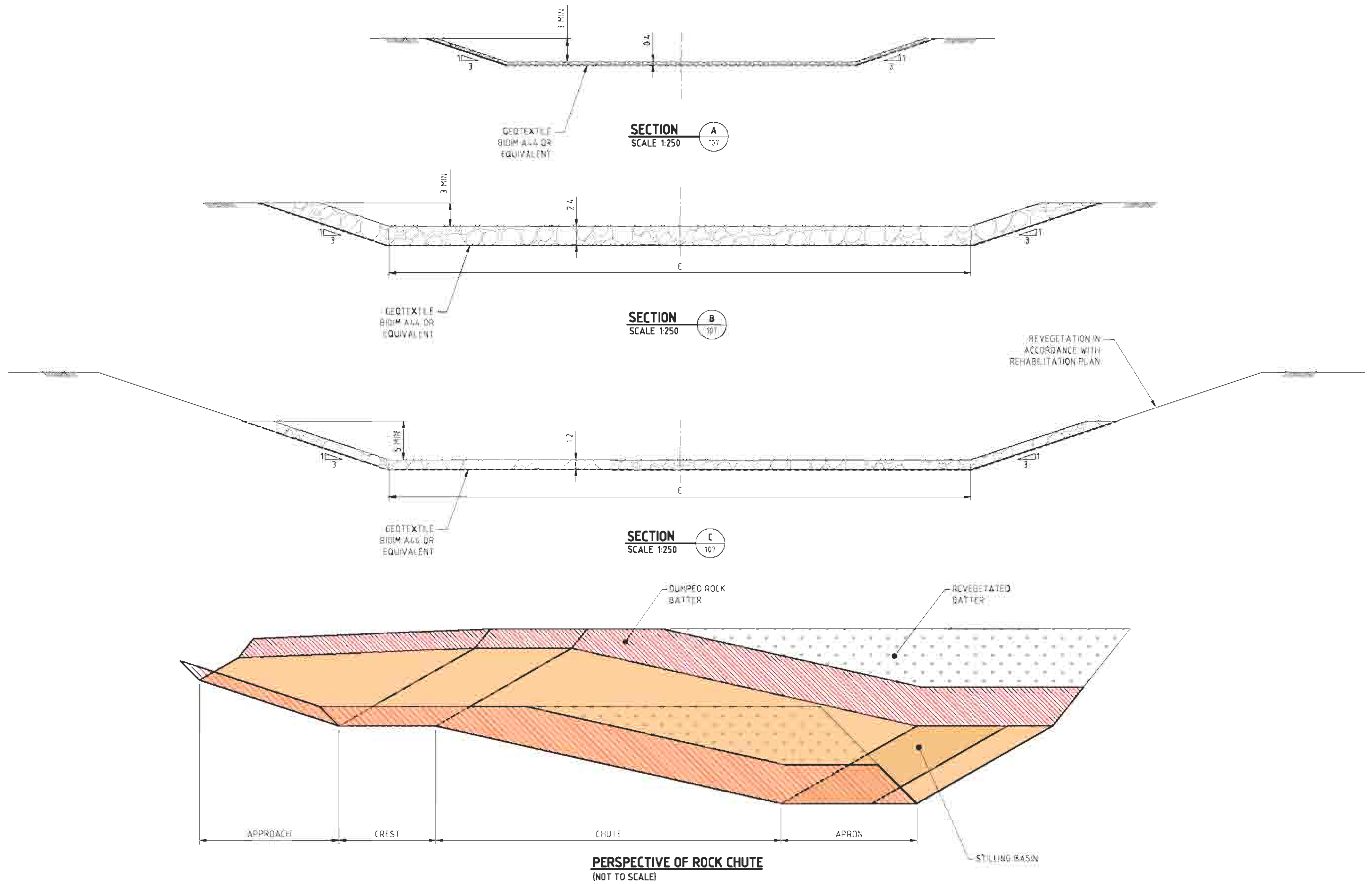
REV	DESCRIPTION	DATE
A	ISSUE FOR REVIEW	16.05.06

	NAME
DRAFTING	S.LINK
DESIGN	G.DOUDALE
DESIGN VERIFICATION	D.LOVELL
PROJECT APPROVAL	G.VYTRSS
CLIENT	

Kellogg Brown & Root Pty Ltd
KBR

TITLE: McARTHUR RIVER MINE EXPANSION PROJECT
MCARTHUR RIVER TRIBUTARIES
ROCK CHUTE DETAILS - SHEET 1 OF 2

DRAWING SCALE: AS SHOWN | DWG SIZE: A1 | PROJECT No.: BEE508
DRAWING No.: BEE508-C-DWG-107 | REVISION: A



PERSPECTIVE OF ROCK CHUTE
(NOT TO SCALE)

NOTE: THIS DRAWING HAS BEEN COMPILED FROM SKETCHES PROVIDED BY CONNELL HATCH

NOT FOR CONSTRUCTION

xstrata

SCALE 1:250

REV	DESCRIPTION	DATE
A	ISSUE FOR REVIEW	16.06.08

	NAME	SIGNATURE
DRAFTING	S.LINK	
DESIGN	G.DUGDALE	
DESIGN VERIFICATION	D.LOVELL	
PROJECT APPROVAL	D.VYTRISS	
CLIENT		

Kellogg Brown & Root Pty Ltd
KBR

TITLE
McARTHUR RIVER MINE
EXPANSION PROJECT
MCARTHUR RIVER TRIBUTARIES
ROCK CHUTE DETAILS - SHEET 2 OF 2

DRAWING SCALE	DWG SIZE	PROJECT No.	DRAWING No.	REVISION
AS SHOWN	A1	BEE508	BEE508-C-DWG-108	A

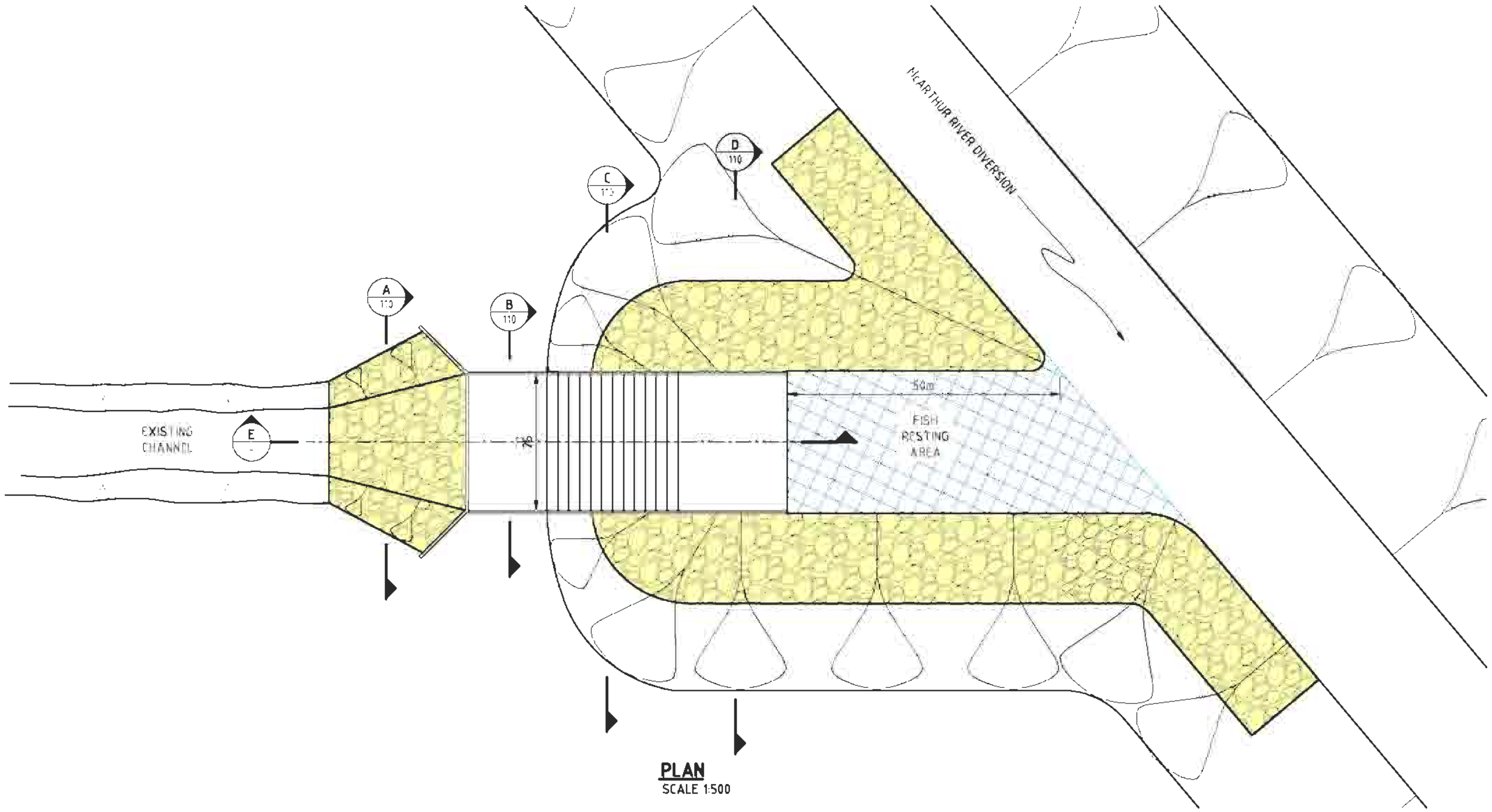
DRAFTER G. SPILLANE

NOTES:

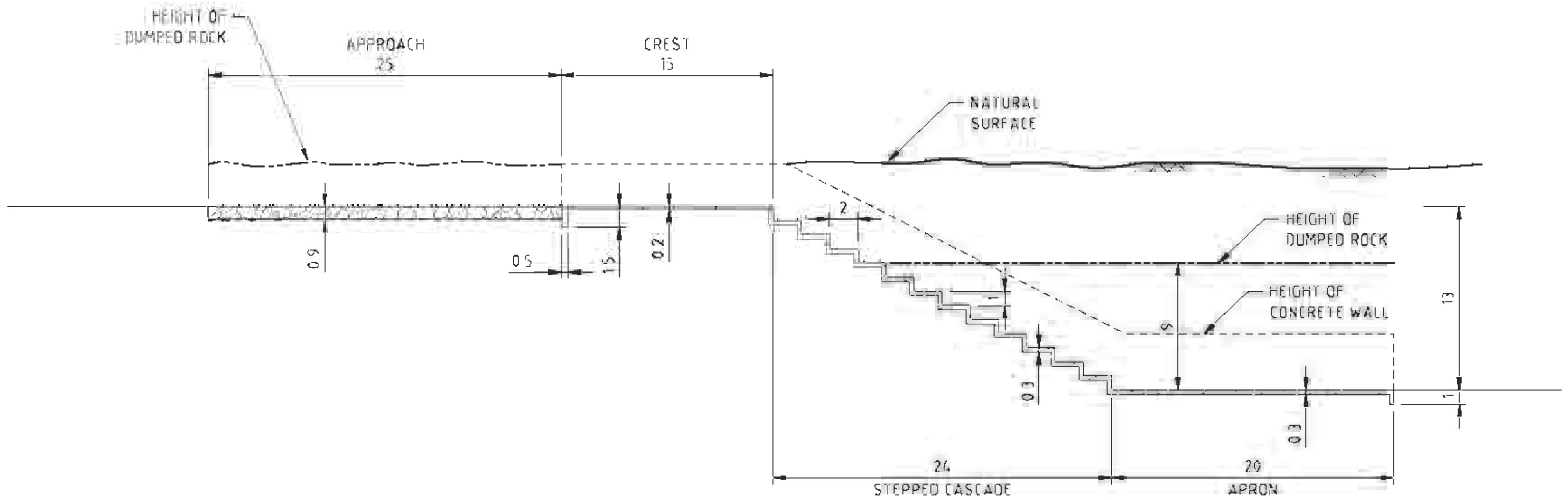
1. PROFILING BACK TO EXISTING CHANNEL AND BANKS SHOULD BE DONE IN SUCH A MANNER AS TO AVOID RAPID EXPANSION IN CROSS-SECTIONAL AREA
2. DUMPED ROCK PROTECTION MAY BE OMITTED WHEN FRESH ROCK IS PRESENT OVER FULL WIDTH OF STRUCTURE
3. FOR DETAILS OF DUMPED ROCK PROTECTION AND GEOTEXTILE REFER TO SPECIFICATION

LEGEND

D50 450mm DUMPED ROCK



PLAN
SCALE 1:500



SECTION E
SCALE 1:250

NOTE: THIS DRAWING HAS BEEN COMPILED FROM SKETCHES PROVIDED BY CONNELL HATCH

NOT FOR CONSTRUCTION

xstrata

DRAWING No.	DESCRIPTION
REFERENCE DRAWINGS	

100mm ON ORIGINAL DRAWING
SCALE 1:250
SCALE 1:500
NOTES

REV	DESCRIPTION	DATE
A	ISSUE FOR REVIEW	16.05.06

REVISIONS

	NAME	SIGNATURE
DRAFTING	S.LINK	
DESIGN	G.DUGDALE	
DESIGN VERIFICATION	G.LOVELL	
PROJECT APPROVAL	G.VITRESS	
CLIENT		

APPROVALS

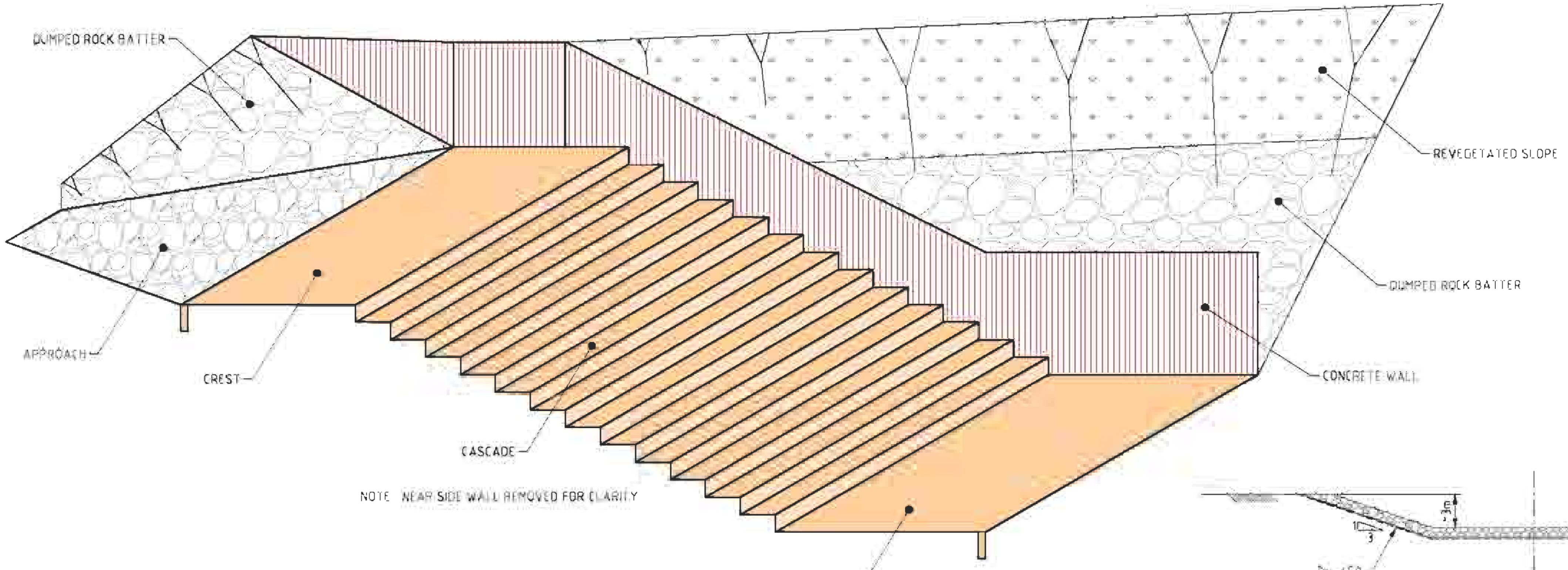
Kellogg Brown & Root Pty Ltd
KBR
Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
550 Coronation Drive, Toowong, Brisbane, Queensland, 4066
ph (07) 3721-6555 fax (07) 3721-6500

DRAWING SCALE	DWG SIZE	PROJECT No.
AS SHOWN	A1	BEE508

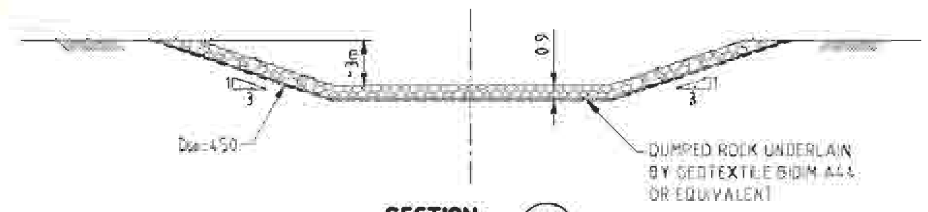
DRAFTER: G. SPILLANE
CAD FILE: BEE508-C-DWG-109.dwg

TITLE
McARTHUR RIVER MINE
EXPANSION PROJECT
BULL CREEK CASCADE
CONCEPT DESIGN - SHEET 1 OF 2

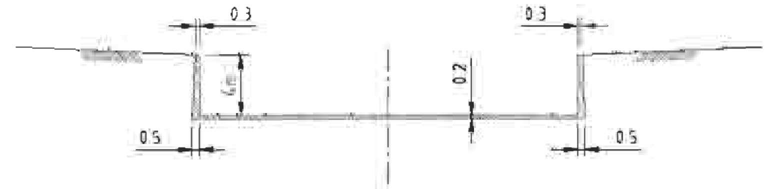
DRAWING No. BEE508-C-DWG-109
REVISION A



PERSPECTIVE OF STEPPED CASCADE
(NOT TO SCALE)

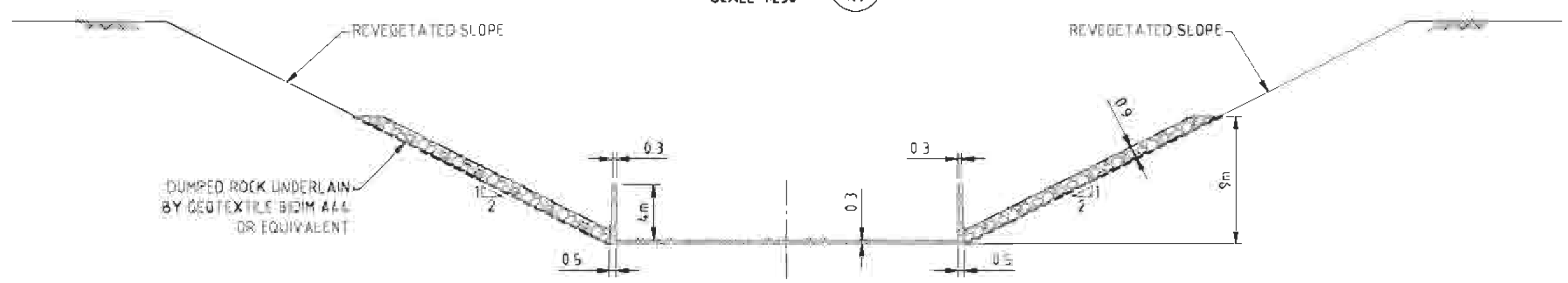


SECTION A / 109
SCALE 1:250



SECTION B / 105
SCALE 1:250

SECTION C / 109
SCALE 1:250



SECTION D / 109
SCALE 1:250

NOTE: THIS DRAWING HAS BEEN COMPILED FROM SKETCHES PROVIDED BY CONNELL HATCH

NOT FOR CONSTRUCTION

xstrata

100mm ON ORIGINAL DRAWING
SCALE 1:250

DRAWING No.	DESCRIPTION
REFERENCE DRAWINGS	

NOTES

REV	DESCRIPTION	DATE
A	ISSUE FOR REVIEW	16.06.06

REVISIONS

	NAME	SIGNATURE
DRAFTING	S.LINK	
DESIGN	G.DUGDALE	
DESIGN VERIFICATION	D.LOVELL	
PROJECT APPROVAL	G.VYTRISS	
CLIENT		

APPROVALS

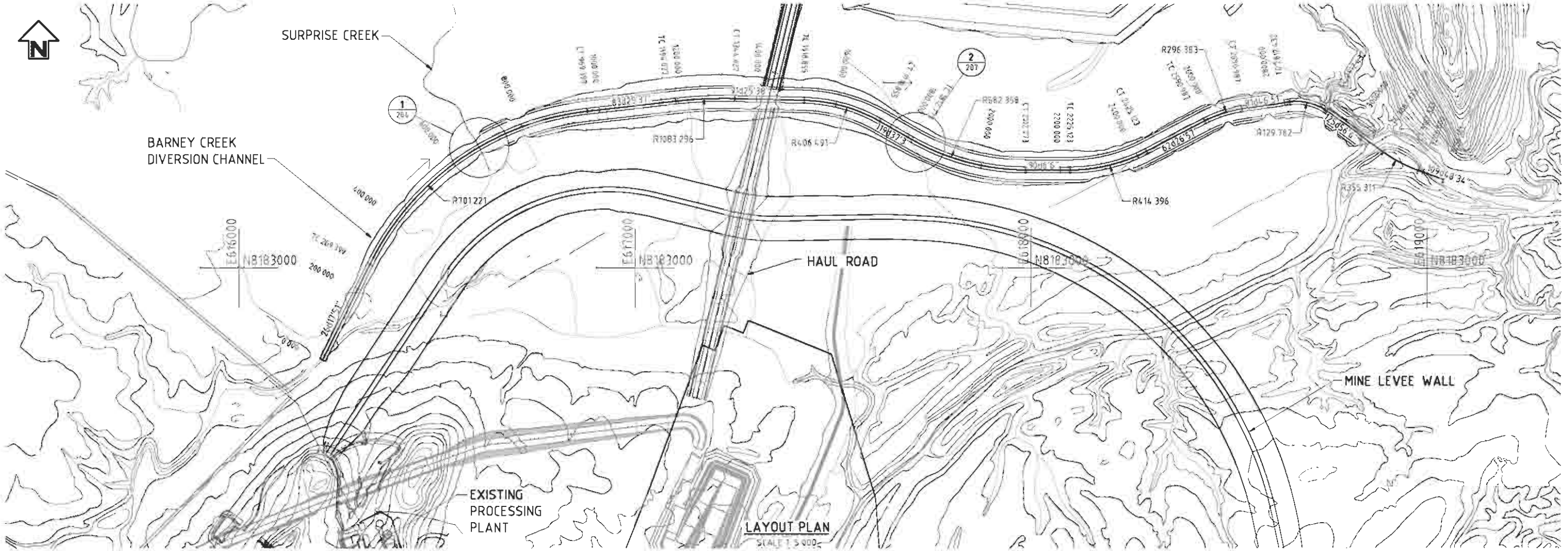
Kellogg Brown & Root Pty Ltd
KBR
Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
550 Coronation Drive, Toowong, Brisbane, Queensland 4066
ph (07) 3721-6555 fax (07) 3721-6500

DRAWING SCALE	DWG SIZE	PROJECT No.
AS SHOWN	A1	BEE508

DRAFTER: G. SPILLANE
CAD FILE: BEE508-C-DWG-110.dwg

TITLE
McARTHUR RIVER MINE
EXPANSION PROJECT
BULL CREEK CASCADE
CONCEPT DESIGN - SHEET 2 OF 2

DRAWING No. BEE508-C-DWG-110
REVISION A



BARNEY CREEK DIVERSION ALIGNMENT SETOUT

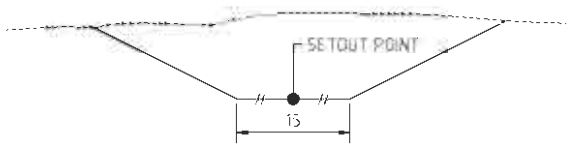
PT	CHAINAGE	EASTING	NORTHING	BEARING	RAD/SPIRAL	TANGENT	DEF ANGLE	ARC LEN
IP1	0 000	6210 869	2767 867	26d17'51"				
	200	6299 475	2947 168	26d17'51"				
TC	269 399	6330 221	3009 384	26d17'51"				
	400	6398 620	3120 420	36d58'08"				
	600	6539 906	3261 019	53d18'38"				
IP2	619 399	6499 587	3352 106		701 221	382 286	57d11'46"	700 000
	800	6715 043	3356 184	69d39'08"				
CT	969 399	6879 411	3395 424	83d29'37"				
	1000	6909 815	3398 802	83d29'37"				
TC	1194 027	7102 593	3420 878	83d29'37"				
	1200	7108 529	3421 538	83d48'34"				
IP3	1269 027	7177 229	3429 390		1083 296	75 120	7d56'01"	150 000
CT	1344 027	7252 326	3427 519	91d25'38"				
	1400	7308 281	3426 125	91d25'38"				
TC	1518 855	7427 099	3423 165	91d25'38"				
	1600	7507 480	3413 088	102d51'53"				
IP4	1618 855	7529 135	3420 623		406 491	102 067	28d11'25"	200 000
CT	1718 855	7617 866	3370 181	119d37'03"				
	1800	7688 470	3330 076	119d37'03"				
TC	1812 773	7699 513	3323 766	119d37'03"				
IP5	1962 773	7832 877	3247 951		582 358	153 408	29d30'57"	300 000
	2000	7874 235	3258 762	101d11'49"				

BARNEY CREEK DIVERSION ALIGNMENT SETOUT (Cont.)

CT	2112 773	7986 285	3247 678	90d06'06"				
	2200	8073 512	3247 523	90d06'06"				
TC	2225 123	8098 635	3247 478	90d06'06"				
IP6	2325 123	8200 622	3247 297		414 396	101 987	27d39'010"	200 000
	2400	8268 432	3283 532	65d55'21"				
CT	2425 123	8291 044	3294 470	62d26'57"				
TC	2590 987	8438 099	3371 189	62d26'57"				
	2600	8446 152	3375 235	64d11'29"				
IP7	2640 987	8482 855	3394 537		296 383	80 680	19d19'54"	100 000
CT	2690 987	8532 816	3401 754	81d46'51"				
	2800	8640 709	3417 339	81d46'51"				
TC	2812 432	8653 014	3419 116	81d46'51"				
IP8	2862 432	8705 104	3426 640		129 762	52 631	44d09'16"	100 000
CT	2912 432	8747 718	3395 753	125d56'06"				
	3000	8818 620	3344 362	125d56'06"				
TC	3087 333	8889 332	3293 109	125d56'06"				
IP9	3137 333	8930 086	3263 570		355 311	50 333	16d07'32"	100 000
CT	3187 333	8977 440	3246 513	109d48'34"				
	3200	8989 357	3242 220	109d48'34"				
IP10	3256 101	9042 138	3223 208	109d48'34"				

NOTES:

1. SURVEY DATUM
   DATUM HORIZONTAL - MRM TRUNCATED
   DATUM VERTICAL - AHD
2. ALL DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE PROJECT SPECIFICATIONS - BEE508-2-SPEC-001.



SETOUT SECTION DETAIL
NTS

NOTE:
SETOUT POINT TO BE TOP SURFACE OF DUMPED ROCK

xstrata

NOT FOR CONSTRUCTION

DRAWING No.	DESCRIPTION
REFERENCE DRAWINGS	

NOTES

REV	DESCRIPTION	DATE
H	MATCH & URS CHANGES	14.06.06
F	SURPRISE CREEK LABEL ADDED	21.05.06
E	MATCH & URS CHANGES	04.05.06
D	MATCH & URS CHANGES	06.04.06
C	BARNEY CREEK ALIGNMENT CHANGED	31.03.06
B	MINE LEVEE WALL AMENDED	16.03.06
A	ISSUE FOR REVIEW	31.10.05

PREVISIONS

	NAME	SIGNATURE
DRAFTING	SLINK	
DESIGN	CLOUGDALE	
DESIGN VERIFICATION	GLOVELL	
PROJECT APPROVAL	DAVIESS	
CLIENT		

APPROVALS

Kellogg Brown & Root Pty Ltd

KBR

Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
555 Coronation Drive Toowong
Brisbane Queensland 4066
po (07) 3721 6555 fax (07) 3721 6500

DRAWING SCALE	ORIG. SIZE	PROJECT No
AS SHOWN	A1	BEE508

DRAFTER C.PIERSON — CAD FILE BEE508-C-DWG-201.dwg

TITLE

McARTHUR RIVER MINE
EXPANSION PROJECT
BARNEY CREEK DIVERSION
SETOUT DETAILS

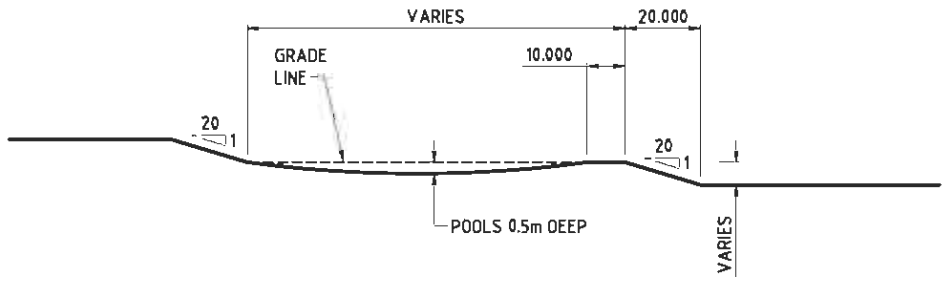
DRAWING No.

BEE508-C-DWG-201

REVISION

G

D:\Projects\Bee\BEE508 - McArthur River Mine\TOS_Drawings\BEE508-C-DWG-201.dwg 21.6.06 10:45



TYPICAL POOL AND STEP DETAIL

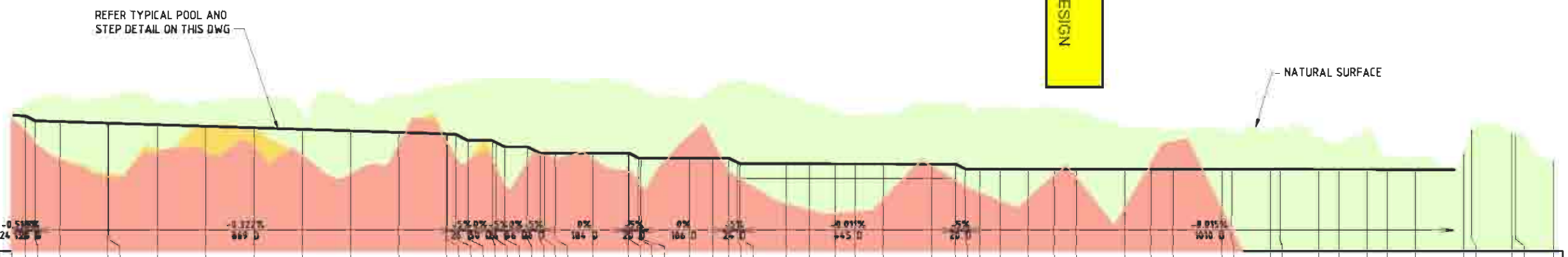
(NOT TO SCALE)

THIS DRAWING IS SUBJECT TO REVISION
REFER TO PER VOLUME 1 FIGURE 5.3 FOR PROPOSED DESIGN

McARTHUR RIVER DIVERSION CHANNEL MATERIAL LEGEND

🟩	CLAY, SILTY CLAY, SANDY CLAY
🟨	WEATHERED (SOFT) ROCK
🟥	FRESH (HARD) ROCK

REFER TYPICAL POOL AND STEP DETAIL ON THIS DWG



PEGGED CHAINAGE	0	28	48	100	198.667	200	300	400	500	600	700	800	898.667	900	917	943
NATURAL SURFACE	28.738	30.189	31.169	32.172	31.684	31.714	30.746	30.946	31.575	28.576	31.341	32.243	34.064	34.051	34.273	35.167
CUT/FILL DEPTH		-2.289	-4.269	-5.44	-5.27	-5.303	-4.658	-5.181	-6.131	-3.454	-6.541	-7.767	-9.905	-9.896	-10.173	-12.367
CHANNEL BED ELEVATION		27.9	26.9	26.732	26.415	26.41	26.088	25.766	25.444	25.121	24.799	24.477	24.159	24.155	24.1	22.8

PEGGED CHAINAGE	993	1000	1019	1065	1091	1100	1123.225	1200	1273.225	1275	1295	1300	1400	1448.052	1481	1500
NATURAL SURFACE	35.446	35.493	35.622	35.669	35.577	35.469	35.189	35.109	34.482	34.434	33.641	33.385	31.383	33.363	34.778	35.074
CUT/FILL DEPTH	-12.646	-13.043	-14.122	-14.169	-15.377	-15.269	-14.989	-14.909	-14.282	-14.234	-14.441	-14.185	-12.183	-14.163	-15.578	-16.824
CHANNEL BED ELEVATION	22.8	22.45	21.5	21.5	20.2	20.2	20.2	20.2	20.2	20.2	19.2	19.2	19.2	19.2	19.2	18.25

PEGGED CHAINAGE	1505	1600	1648.052	1700	1741.97	1800	1900	1950	1970	2000	2041.97	2100	2154.32	2200	2300	2354.32
NATURAL SURFACE	35.058	32.161	30.623	28.718	27.953	28.023	30.64	30.307	30.055	29.476	29.596	29.102	29.661	28.846	25.543	25.324
CUT/FILL DEPTH	-17.058	-14.171	-12.639	-10.74	-9.98	-10.056	-12.684	-12.357	-13.105	-12.531	-12.657	-12.171	-12.738	-11.93	-8.642	-8.431
CHANNEL BED ELEVATION	18	17.989	17.984	17.978	17.973	17.967	17.956	17.95	16.95	16.946	16.939	16.931	16.923	16.916	16.901	16.893

PEGGED CHAINAGE	2400	2500	2520.184	2600	2620.184	2700	2741.629	2800	2841.629	2900	3000	3016.53	3100	3116.53	3185.298
NATURAL SURFACE	24.899	25.239	24.653	24.93	25.385	23.257	22.137	24.74	14.205	19.247	20.021	25.083	24.168	24	18.607
CUT/FILL DEPTH	-8.013	-8.368	-7.784	-8.073	-8.531	-6.415	-5.302	-7.913	2.615	-2.436					
CHANNEL BED ELEVATION	16.886	16.871	16.868	16.856	16.853	16.842	16.835	16.827	16.821	16.812					

CROSS SECTION TYPE: TYPE A | TYPE C | TYPE A | TYPE C | TYPE B | TYPE C | TYPE B

CHANNEL BOTTOM WIDTH: 15m | 30m

DUMPED ROCK D50 (mm): 300mm | 750 - 1000mm | 250mm ON BANKS

DUMPED ROCK THICKNESS: 1.0m | 1.5 - 2.0m | 1.0m

BARNEY CREEK DIVERSION CHANNEL

SCALE: HORIZ 1:5000 VERT 1:500

NOT FOR CONSTRUCTION

xstrata

© Kellogg Brown & Root Pty Ltd

SCALE 1:5000
SCALE 1:500

REV	DESCRIPTION	DATE
G	HATCH CHANGES	30.06.06
F	HATCH & URS CHANGES	16.06.06
E	HATCH CHANGES AND COLOUR ADDED	21.05.06
D	HATCH & URS CHANGES	11.05.06
C	HATCH & URS CHANGES	04.04.06
B	ALIGNMENT REVISED	22.02.06
A	ISSUED FOR REVIEW	23.12.05

REVISIONS

	NAME	SIGNATURE
DRAFTING	Y.LUBE	
DESIGN	G.DUGDALE	
DESIGN VERIFICATION	G.LOVELL	
PROJECT APPROVAL	D.VINESS	
CLIENT		

APPROVALS

REFERENCE DRAWINGS
DRG No. | DESCRIPTION
NOTES

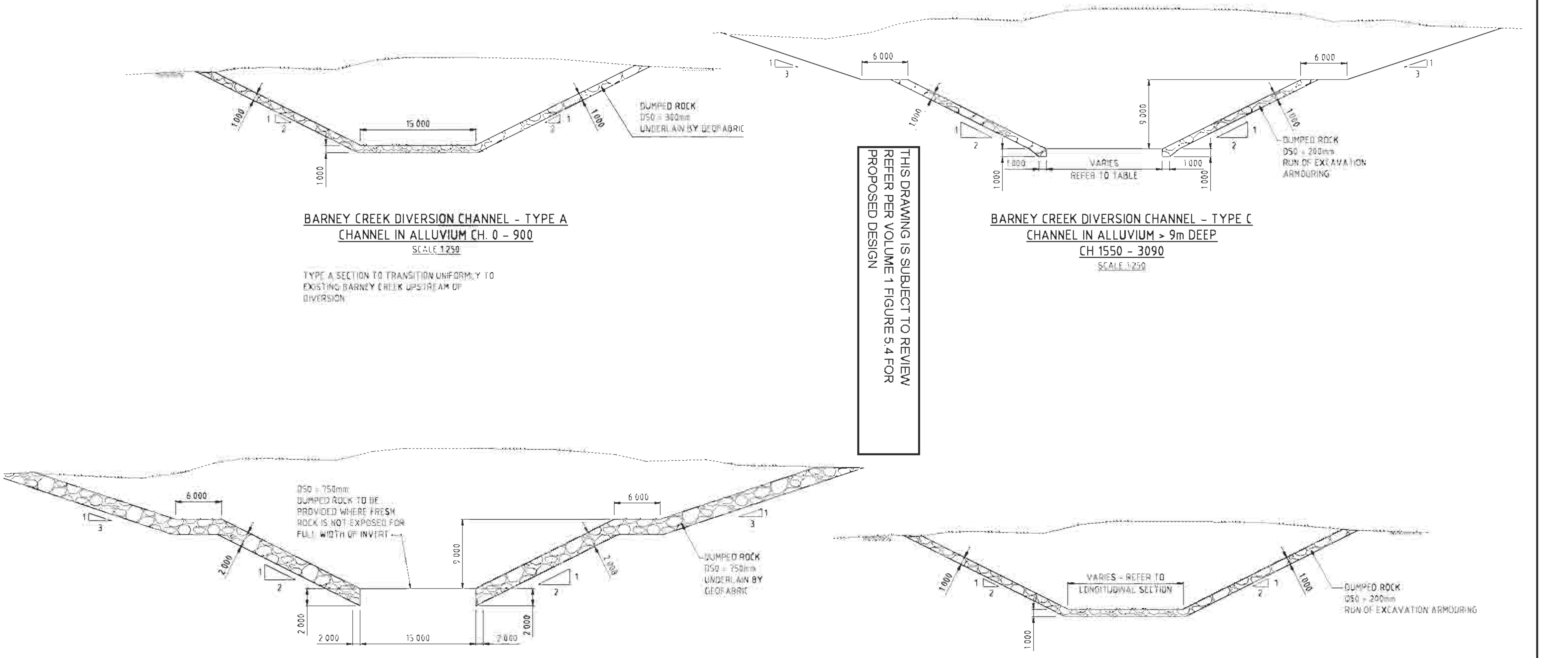
Kellogg Brown & Root Pty Ltd
KBR
Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
199 Coronation Drive, Toowong,
Brisbane, Queensland, 4066
ph (07) 3721-6555 fax (07) 3721-6500

DRAWING SCALE: AS SHOWN
ORIG. SIZE: A1
PROJECT No.: BEE508
DRAFTER: Y.FRASER
CAD FILE: BEE508-C-DWG-202.DWG

TITLE
McARTHUR RIVER MINE
EXPANSION PROJECT
BARNEY CREEK DIVERSION
LONGITUDINAL SECTION

DRAWING No.: BEE508-C-DWG-202
REVISION: G

THIS DRAWING IS SUBJECT TO REVIEW
REFER PER VOLUME 1 FIGURE 5.4 FOR
PROPOSED DESIGN



BARNEY CREEK DIVERSION CHANNEL - TYPE A
CHANNEL IN ALLUVIUM CH. 0 - 900
SCALE 1:250

TYPE A SECTION TO TRANSITION UNIFORMLY TO EXISTING BARNEY CREEK UPSTREAM OF DIVERSION

BARNEY CREEK DIVERSION CHANNEL - TYPE C
CHANNEL IN ALLUVIUM > 9m DEEP
CH 1550 - 3090
SCALE 1:250

BARNEY CREEK DIVERSION CHANNEL - TYPE B
CHANNEL CH. 900 - 1550
SCALE 1:250

BARNEY CREEK DIVERSION CHANNEL - TYPE C
CHANNEL IN ALLUVIUM < 9m DEEP
CH. 1550 - 3090
SCALE 1:250

xstrata

 XREFS

NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE
H	HATCH CHANGES	30.06.06
G	HATCH & URS CHANGES	16.06.06
F	HATCH & URS CHANGES	04.05.06
E	HATCH & URS CHANGES	26.04.06
D	BARNEY CREEK DIVERSION TABLE ADDED	01.03.06
C	ADDITIONAL SECTIONS ADDED	27.02.06
B	BARNEY CREEK DIVERSION CHANNEL AMENDED	13.02.06
C	ISSUE FOR REVIEW	21.12.05

REVISIONS

	NAME	SIGNATURE
DRAFTING	S.LAK	
DESIGN	G.DOUGLAS	
DESIGN VERIFICATION	G.LOVELL	
PROJECT APPROVAL	D.VEHRESS	
CLIENT		

APPROVALS

SCALE 1:250 — SCALE IN m

REFERENCE DRAWINGS — DRAWING No. — DESCRIPTION

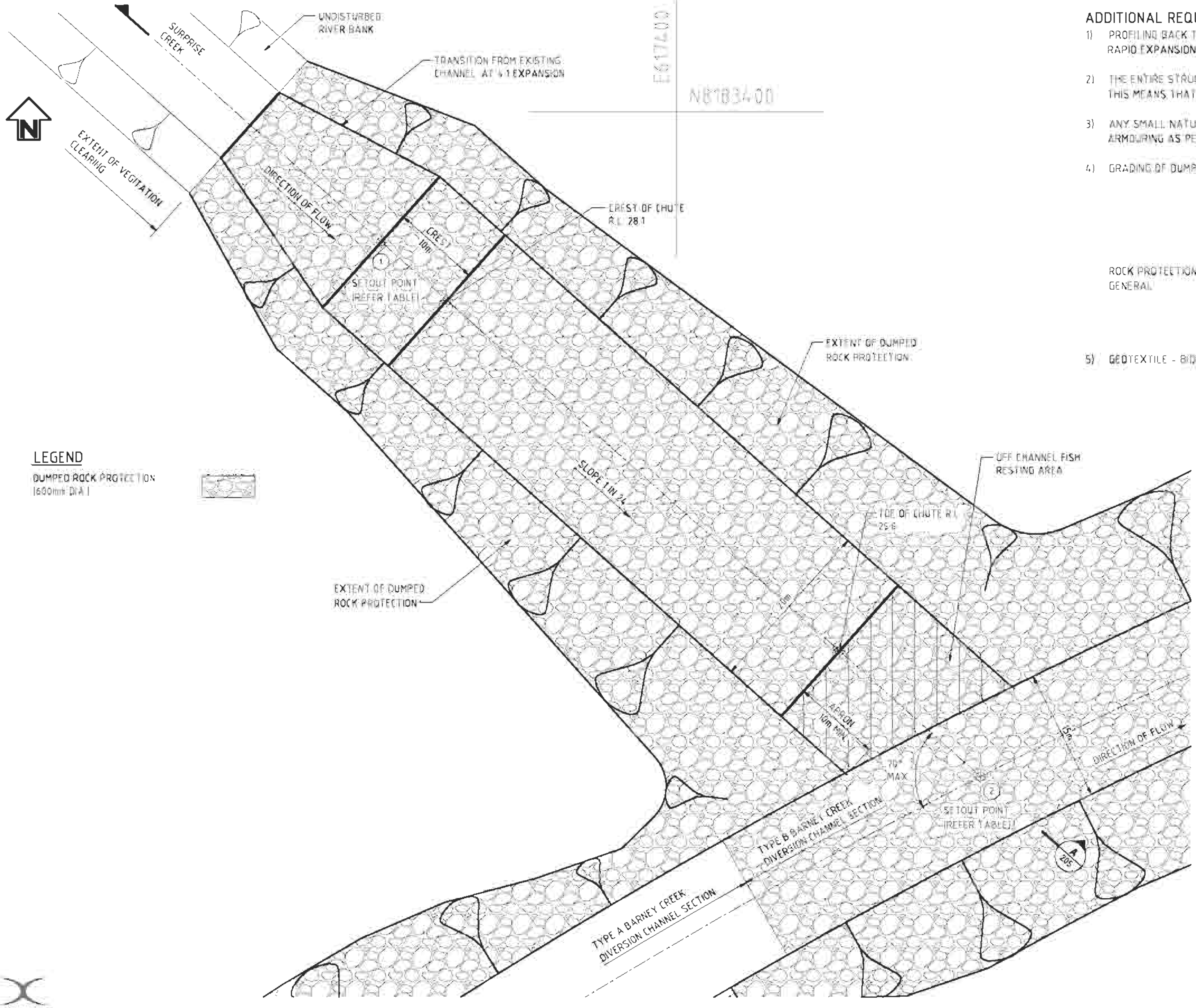
NOTES

Kellogg Brown & Root Pty Ltd
KBR
Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
555 Coronation Drive, Toowong
Brisbane, Queensland 4066
ph (07) 3721-6555 fax (07) 3721-6500

TITLE
McARTHUR RIVER MINE
EXPANSION PROJECT
BARNEY CREEK DIVERSION
TYPICAL SECTION

DRAWING SCALE	DRG. SIZE	PROJECT No.	DRAWING No.	REVISION
AS SHOWN	A1	BEE508	BEE508-C-DWG-203	H

DRAFTER C.F.ISON — CAD FILE BEE508-C-DWG-203.dwg



LEGEND

DUMPED ROCK PROTECTION (600mm DIA.)

ADDITIONAL REQUIREMENTS

1) PROFILING BACK TO THE EXISTING TOPOGRAPHY/TRIBUTARY BED SHOULD BE DONE IN SUCH A MANNER AS TO AVOID RAPID EXPANSION IN CROSS-SECTION AREA. CROSS SECTION EXPANSION SHOULD BE GREATER OR EQUAL TO 4 TO 1

2) THE ENTIRE STRUCTURE SHALL BE CONSTRUCTED SUCH THAT THERE WILL BE NO CONCENTRATION OF FLOW AT ANY POINT. THIS MEANS THAT IT MUST BE LEVEL ACROSS ITS WIDTH FOR THE ENTIRE DISTURBED AREA (EXCEPT BATTERS)

3) ANY SMALL NATURAL DRAINS THAT ENTER THE CHUTE (E.G. VIA BATTERS) WILL BE TREATED BY PLACING ROCK ARMOURING AS PER INTERSECTING TRIBUTARY DETAIL

4) GRADING OF DUMPED ROCK PROTECTION

ROCK SIZE (mm)	% PASSING BY WEIGHT
900	100
600	40 to 60
250	< 20

ROCK PROTECTION GENERAL

- × 25 MPa GREATER THAN OR EQUAL TO ROCK CRUSHING STRENGTH
- × LENGTH < 2.5m WIDTH OR THICKNESS
- × ANGULAR IN SHAPE
- × FREE OF DIFFUSED CLEAVAGE PLANES
- × NOT ADVERSELY AFFECTED BY REPEATED WETTING AND DRYING

5) GEOTEXTILE - BIDIM A44 OR APPROVED EQUIVALENT

SETOUT TABLE

PT No	EASTING	NORTHING	LEVEL
1	6566 323	3385 071	28.287
2	6634 586	3324 161	25.555

DETAIL (1 / 201)
SCALE 1:250

NOTE: THIS DRAWING HAS BEEN COMPILED FROM SKETCHES PROVIDED BY CONNELL HATCH

NOT FOR CONSTRUCTION

xstrata

DRAWING No.	DESCRIPTION
REFERENCE DRAWINGS	

100mm ON ORIGINAL DRAWING · SCALE 1:250 · NOTES

REV	DESCRIPTION	DATE
F	HATCH CHANGES	23.03.06
E	DRAWING COMPILED FROM HATCH SKETCHES ROCK ADDED	17.05.06
D	HATCH & URS CHANGES	06.05.06
C	HATCH & URS CHANGES	24.04.06
B	APPROX ROCK VOLUME ADDED	21.03.06
A	ISSUE FOR REVIEW	21.12.05

REVISIONS

	NAME	SIGNATURE
DRAFTING	S.LINK	
DESIGN	D.DOUGALL	
DESIGN VERIFICATION	D.LOVELL	
PROJECT APPROVAL	D.VENESS	
CLIENT		

APPROVALS

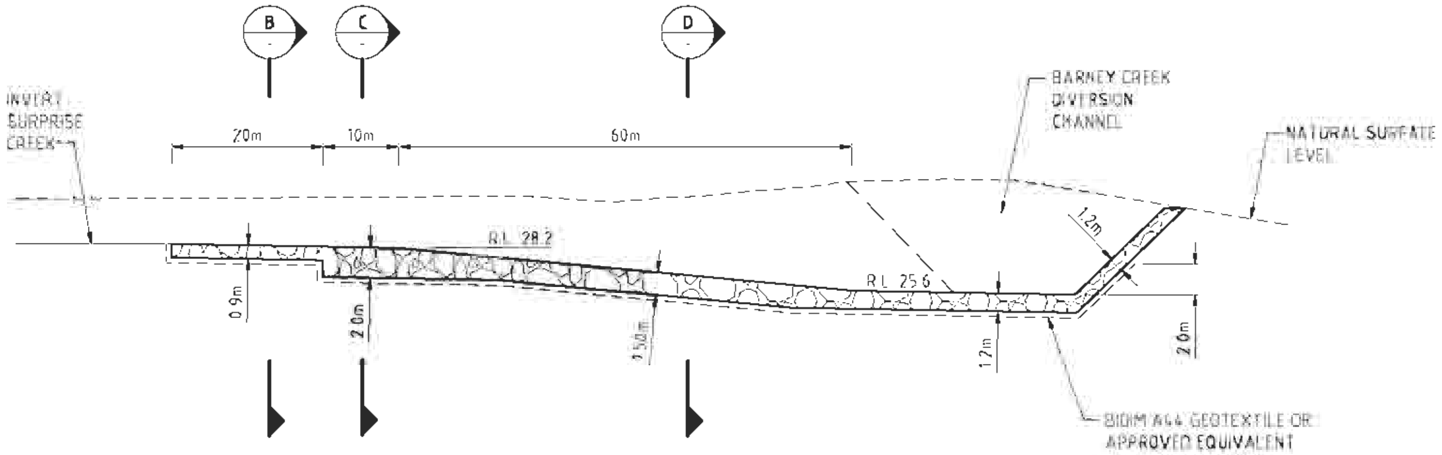
Kellogg Brown & Root Pty Ltd
KBR
Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
199 Coronation Drive, Toowong, Brisbane, Queensland, 4066
ph (07) 3721-6555 fax (07) 3721-6500

DRAWING SCALE	ORIG. SIZE	PROJECT No.
AS SHOWN	A1	BEE508

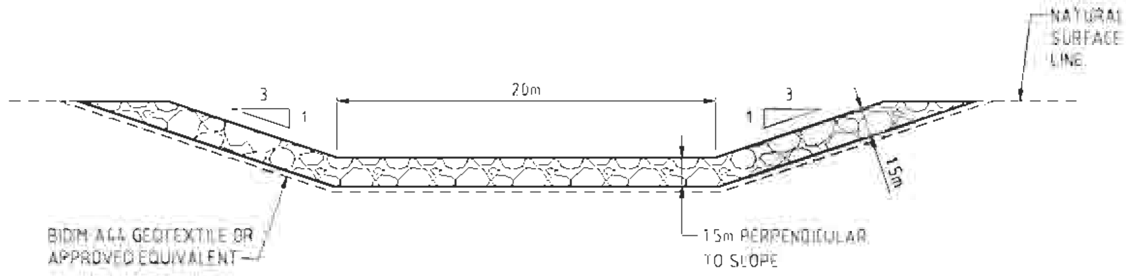
DRAFTER: CRITSON · CAD FILE: BEE508-C-DWG-204.dwg

TITLE
McARTHUR RIVER MINE
EXPANSION PROJECT
BARNEY CREEK DIVERSION
SURPRISE CREEK CHUTE DETAILS - SHEET 1 OF 2

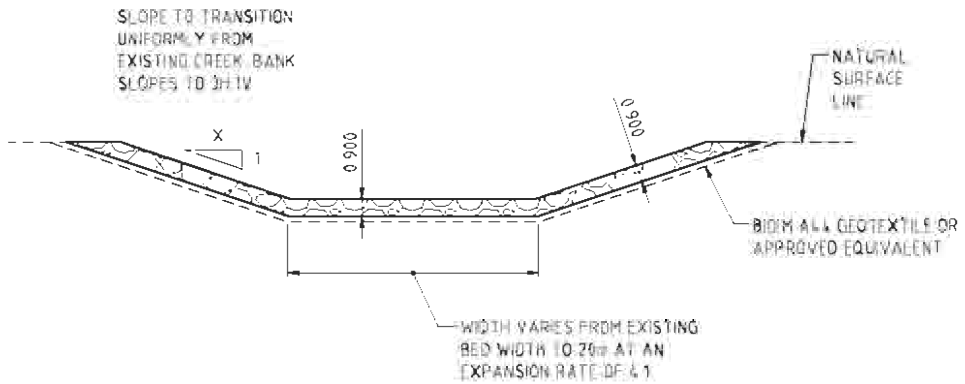
DRAWING No.: BEE508-C-DWG-204
REVISION: F



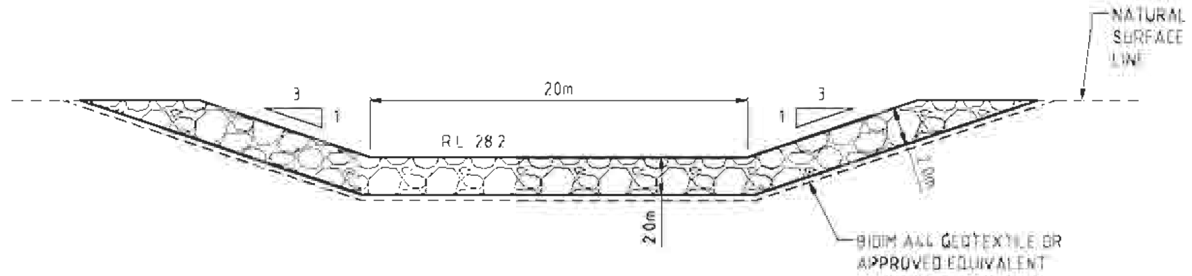
SURPRISE CREEK CHUTE SECTION (A / 205)
SCALE 1:500 HORIZ
1:250 VERT



CHUTE SECTION (D)
SCALE 1:200



CHUTE APPROACH SECTION (B)
SCALE 1:200



CHUTE CREST SECTION (C)
SCALE 1:200

xstrata

NOTE: THIS DRAWING HAS BEEN COMPILED FROM SKETCHES PROVIDED BY CONNELL HATCH

NOT FOR CONSTRUCTION

DRAWING No.	DESCRIPTION
REFERENCE DRAWINGS	

NOTES

100mm ON ORIGINAL DRAWING
SCALE 1:500
SCALE 1:250
SCALE 1:200

REV	DESCRIPTION	DATE
D	DRAWING COMPILED FROM HATCH SKETCHES NOTE ADDED	12.05.06
C	HATCH & URS CHANGES	04.04.06
B	SECTION C MODIFIED	11.02.06
A	ISSUE FOR REVIEW	21.12.05
REVISIONS		

	NAME	SIGNATURE
DRAFTING	S.LINK	
DESIGN	CLOUGONLE	
DESIGN VERIFICATION	G.LOVELL	
PROJECT APPROVAL	G.WATTERS	
CLIENT		
APPROVALS		

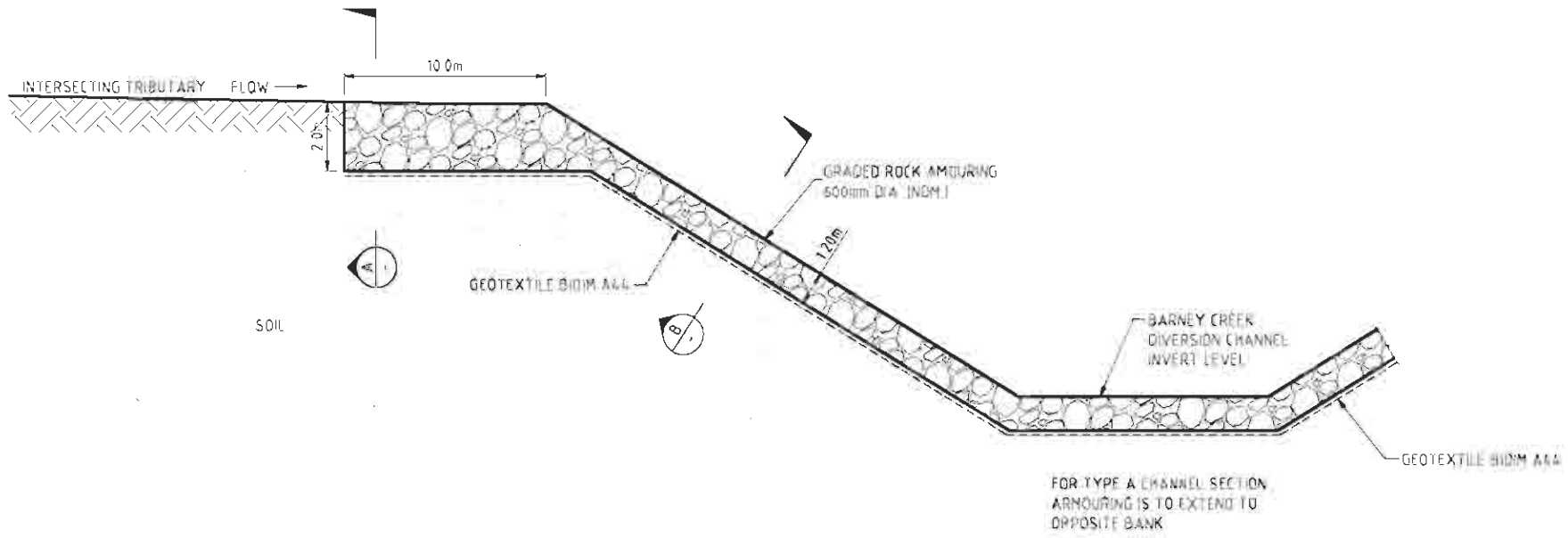
Kellogg Brown & Root Pty Ltd
KBR
Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
186 Coronation Drive, Toowong, Brisbane, Queensland, 4066
ph (07) 3721-6555 fax (07) 3721-6500

DRAWING SCALE	DWG SIZE	PROJECT No.
AS SHOWN	A1	BEE508

DRAFTER C.RITSON
CAD FILE BEE508-C-DWG-205.dwg

TITLE
McARTHUR RIVER MINE
EXPANSION PROJECT
BARNEY CREEK DIVERSION
SURPRISE CREEK CHUTE DETAILS - SHEET 2 OF 2

DRAWING No. BEE508-C-DWG-205
REVISION D



TYPICAL SECTION
NTS

ADDITIONAL REQUIREMENTS

1) PROFILING BACK TO THE EXISTING TOPOGRAPHY/TRIBUTARY BED SHOULD BE DONE IN SUCH A MANNER AS TO AVOID RAPID EXPANSION IN CROSS-SECTION AREA.

2) THE ENTIRE STRUCTURE SHALL BE CONSTRUCTED SUCH THAT THERE WILL BE NO CONCENTRATION OF FLOW AT ANY POINT. THIS MEANS THAT IT MUST BE LEVEL ACROSS ITS WIDTH FOR THE ENTIRE DISTURBED AREA (EXCEPT BATTERS).

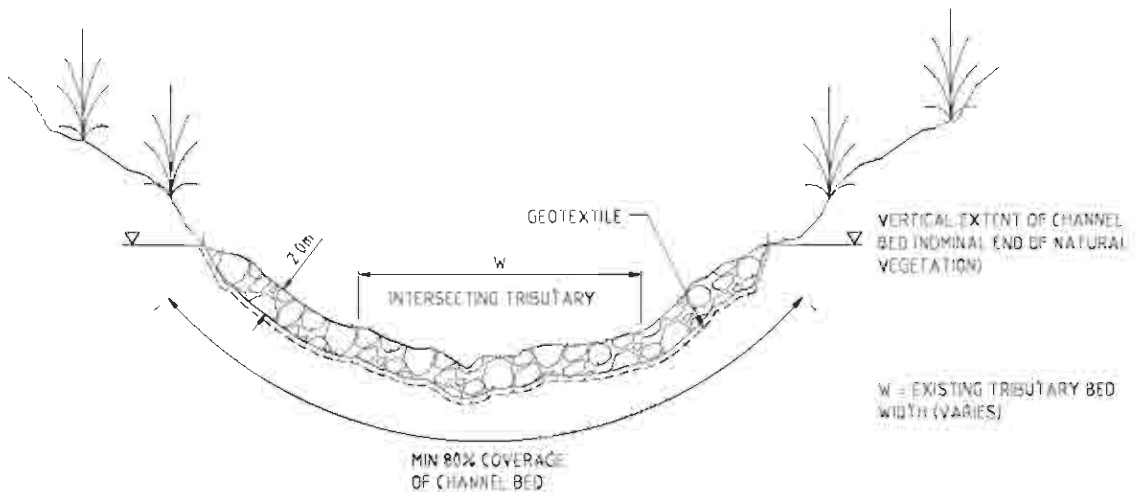
3) ANY SMALL NATURAL DRAINS THAT ENTER THE CHUTE (E.G. VIA BATTERS) WILL BE TREATED BY PLACING ROCK ARMOURING AS PER INTERSECTING TRIBUTARY DETAILS.

4) GRADING OF ROCK ARMOURING — 600mm DIAMETER (NOM.)

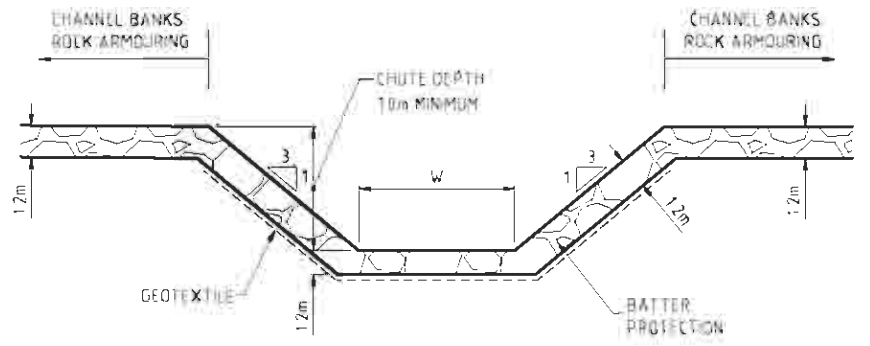
ROCK SIZE (mm)	% PASSING BY WEIGHT
990	100
600	40 TO 60
250	< 20

ROCK PROTECTION GENERAL
- ≥ 25 MPa GREATER THAN OR EQUAL TO ROCK CRUSHING STRENGTH
- LENGTH ≥ 2.5× WIDTH OR THICKNESS
- ANGULAR IN SHAPE
- FREE OF DIFFUSED CLEAVAGE PLANES
- NOT ADVERSELY AFFECTED BY REPEATED WETTING AND DRYING

5) GEOTEXTILE - BIDIM A44 OR APPROVED EQUIVALENT



SECTION A
NTS



SECTION B
NTS

xstrata

NOT FOR CONSTRUCTION

DRAWING No.	DESCRIPTION
REFERENCE DRAWINGS	

100mm ON ORIGINAL DRAWING

NOT TO SCALE

NOTES

REV	DESCRIPTION	DATE
C	MATCH & DRG CHANGES	26.04.06
B	PLANNING ROCK VOLUME ADDED	31.03.06
A	ISSUE FOR REVIEW	24.03.06

REVISIONS

	NAME	SIGNATURE
DRAFTING	S.LINK	
DESIGN	G.DUGDALE	
DESIGN VERIFICATION	C.L.DAVEY	
PROJECT APPROVAL	D.VENESS	
CLIENT		

APPROVALS

Kellogg Brown & Root Pty Ltd
KBR
Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
555 Coronation Drive, Toowong
Brisbane Queensland 4066
ph (07) 3721-6555 fax (07) 3721-6500

TITLE
McARTHUR RIVER MINE
EXPANSION PROJECT
BARNEY CREEK DIVERSION
TYPICAL DETAILS - TRIBUTARY TREATMENT DETAILS

DRAWING SCALE	ORIG. SIZE	PROJECT No.
AS SHOWN	A1	BEE508

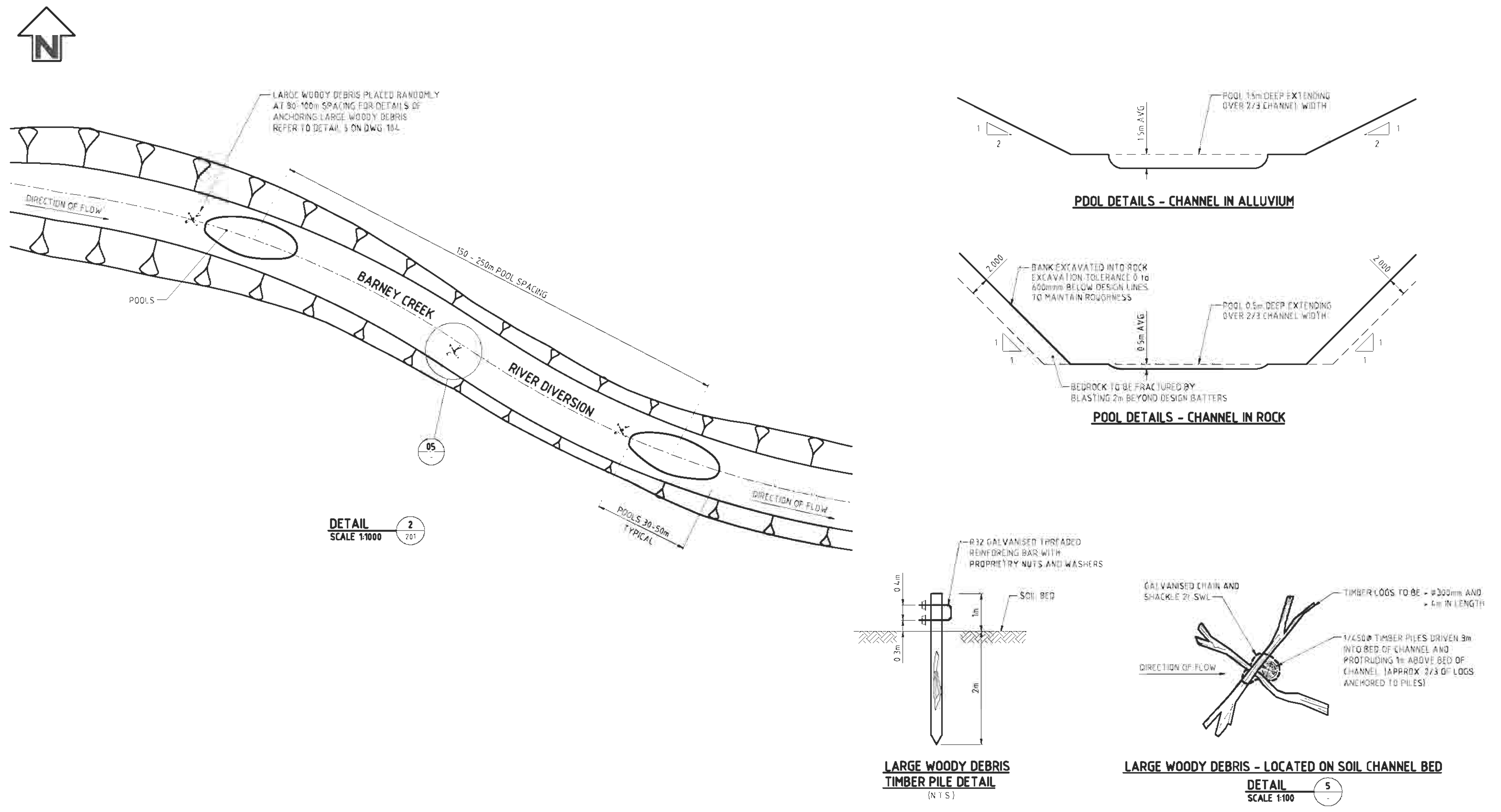
DRAWING No. BEE508-C-DWG-206

REV'S DY: C

DRAFTER Y.FRASER

CAD FILE BEE508-C-DWG-206.dwg

I:\Jobs\Projects\Bee\BEE508 - McArthur River Mine\TSF_Drawings\BEE508-C-DWG-206.dwg 25 Aug 06 11:08



xstrata

NOTE: THIS DRAWING HAS BEEN COMPILED FROM SKETCHES PROVIDED BY CONNELL HATCH

NOT FOR CONSTRUCTION

XREFS

REFERENCE DRAWINGS

DRAWING No.	DESCRIPTION

NOTES

100mm ON ORIGINAL DRAWING

SCALE 1:1000 · SCALE 1:250 · SCALE 1:200

REVISIONS

REV	DESCRIPTION	DATE
E	HATCH & GHS CHANGES	16.06.06
D	HATCH CHANGES	21.05.06
C	DRAWING COMPILED FROM HATCH SKETCHES (NOTE ADDED)	17.05.06
B	HATCH & GHS CHANGES	04.05.06
A	ISSUE FOR REVIEW	04.04.06

APPROVALS

	NAME	SIGNATURE
DRAFTING	S.LINK	
DESIGN	G.DUGDALE	
DESIGN VERIFICATION	G.LOVELL	
PROJECT APPROVAL	D.VENESS	
CLIENT		

Kellogg Brown & Root Pty Ltd

KBR

Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
555 Coronation Drive, Toowong, Brisbane, Queensland, 4066
ph (07) 3721-6555 fax (07) 3721-6500

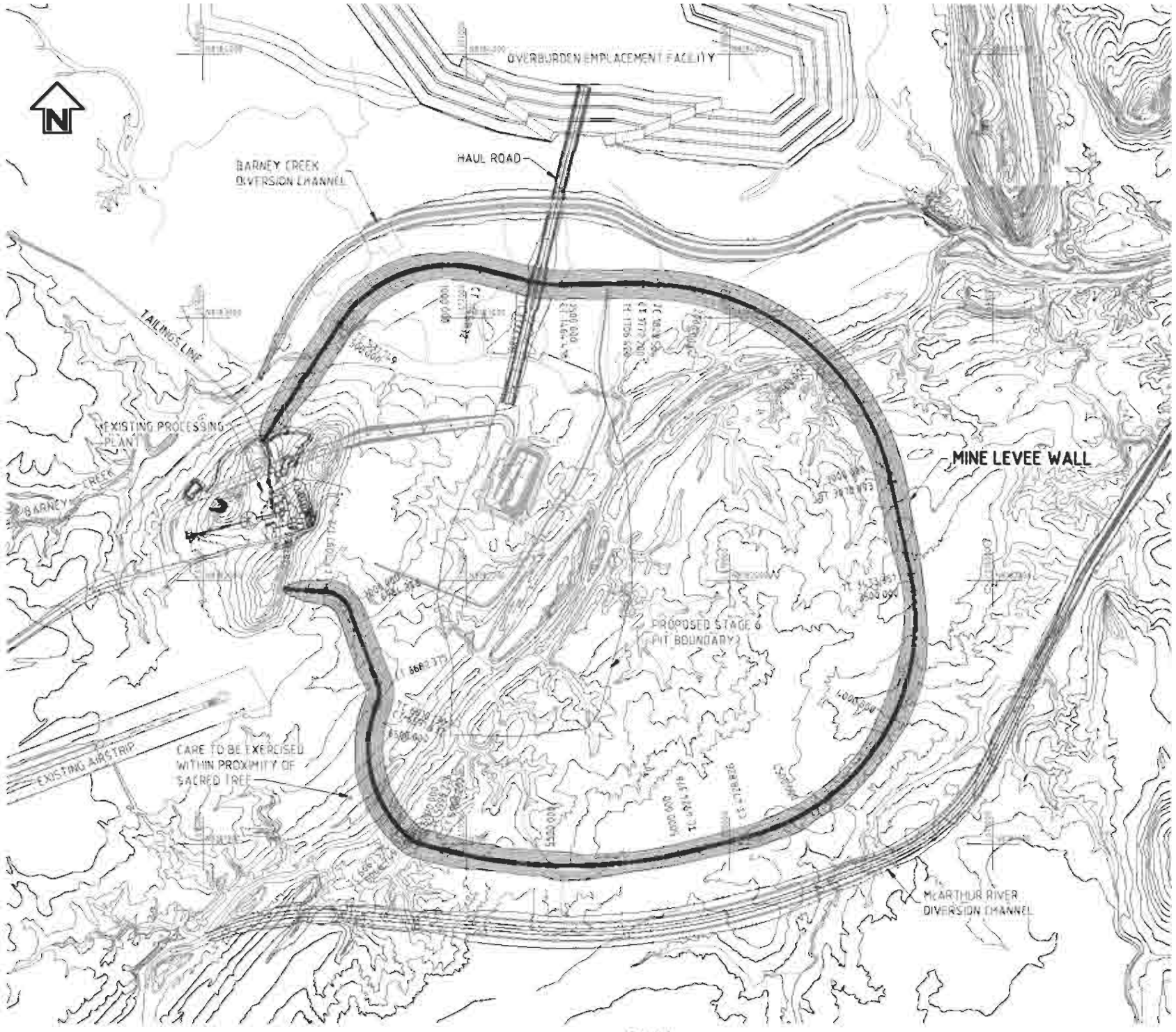
DRAWING SCALE: AS SHOWN | ORIG. SIZE: A1 | PROJECT No.: BEE508

DRAFTER: Y.FRASER | CAD FILE: BEE508-C-DWG-207.dwg

TITLE:
McARTHUR RIVER MINE
EXPANSION PROJECT
BARNEY CREEK DIVERSION
TYPICAL BED DETAILS

DRAWING No.: BEE508-C-DWG-207

REVISION: E



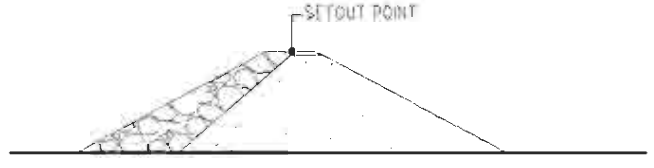
LAYOUT PLAN
SCALE 1:10 000

TOP OF LEVEE ALIGNMENT SETOUT

PT	CHAINAGE	EASTING	NORTHING	LEVEL	BEARING	RAD/SPIRAL	A LENGTH	D ANGLE
IP1	0.000	6224.786	2529.880	44.500				
TC	531.749	6517.598	2973.748	44.500	33°24'44"			
IP2	839.291	6712.121	3268.621			500.000	615.083	70°28'60"
CT	1146.832	7059.039	3183.786	44.500	103°53'44"			
TC	1333.588	7236.330	3138.936	44.500	103°53'44"			
IP3	1398.999	7300.191	3123.138			500.000	-130.822	14°59'28"
CT	1464.410	7365.986	3124.396	44.500	88°54'16"			
TC	1705.428	7607.938	3129.023	44.500	88°54'16"			
IP4	1739.313	7640.851	3128.652			1000.000	65.774	3°46'07"
CT	1772.200	7673.694	3128.118	44.500	92°40'23"			
TC	1828.564	7729.998	3126.489	43.998	92°40'23"			
IP5	2453.729	8483.560	3091.242			950.000	1250.329	75°24'33"
CT	3078.893	8615.214	2372.708	43.943	168°04'55"			
TC	3433.851	8688.414	2025.891	44.136	168°04'55"			
IP6	4081.088	8855.985	1732.180			850.000	1295.475	87°19'26"
CT	4728.826	8870.811	1027.782	44.500	255°24'21"			
TC	4924.316	7881.670	978.510	44.500	255°24'21"			
IP7	5416.289	7295.045	951.807			1930.000	983.827	29°12'24"
CT	5908.202	6908.461	978.667	44.500	284°36'46"			
TC	5998.226	6821.350	1001.339	44.500	284°36'46"			
IP8	6022.486	6797.349	1007.636			95.000	48.523	29°15'54"
CT	6046.749	6779.470	1024.828	44.500	313°52'40"			
TC	6067.524	6764.495	1039.227	44.500	313°52'40"			
IP9	6329.478	6550.994	1244.524			450.000	523.908	66°42'22"
CT	6591.432	6655.128	1521.806	44.500	20°35'02"			
TC	6610.130	6661.782	1539.310	44.500	20°35'02"			
IP10	6646.253	6674.985	1574.679			100.000	-72.245	41°23'37"
CT	6682.376	6661.563	1609.995	44.500	339°11'25"			
TC	6984.348	6554.287	1892.268	44.000	339°11'25"			
IP11	7040.760	6531.804	1951.411			100.000	-112.824	64°38'36"
CT	7097.172	6468.733	1956.427	44.500	274°32'49"			
IP12	7261.026	6305.395	1969.416	44.500				

NOTE:

1. SURVEY DATUM
   DATUM HORIZONTAL - MGA TRUNCATED
   DATUM VERTICAL - AHD
2. ALL DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE PROJECT SPECIFICATIONS - BEE508-Z-SPEC-001 Rev 0.
3. COORDINATES OF SACRED TREE ARE E 6558.53, N 1175.87



MINE LEVEE WALL TYPICAL SECTION
(CH.00 - CH.7261)
SCALE 1:500

NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE
E	METER & UBS CHANGES	27.06.06
D	OPT LAYOUT AMENDED	18.04.06
C	BARNEY CREEK ALIGNMENT CHANGED	21.03.06
B	MINE LEVEE WALL AMENDED	14.02.06
A	ISSUE FOR REVIEW	21.12.05

	NAME	SIGNATURE
DRAFTING	S.LINK	
DESIGN	R.RUGGIATI	
DESIGN VERIFICATION	R.LOVELL	
PROJECT APPROVAL	G.ATKINSS	
CLIENT		

Kellogg Brown & Root Pty Ltd
KBR
Kellogg Brown & Root Pty Ltd ABN 91 003 660 317
555 Coronation Drive, Toowong,
Brisbane, Queensland, 4066
ph (07) 3721-6555 fax (07) 3721-6600

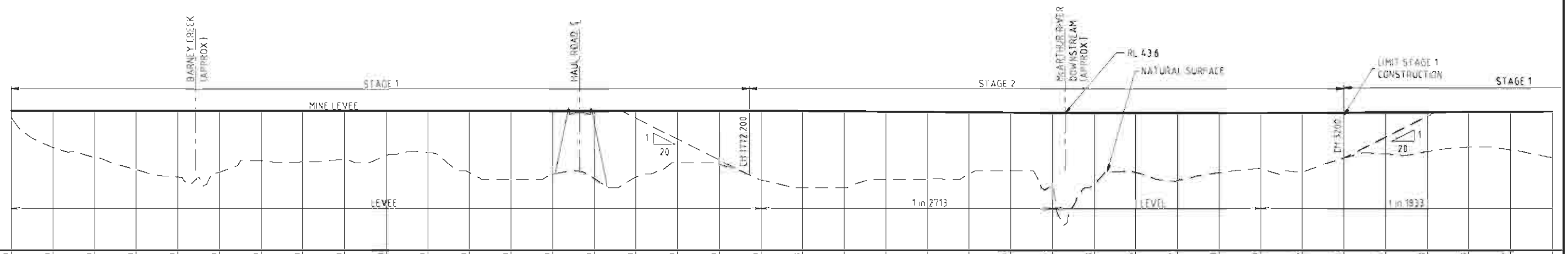
DRAFTER: Y.FRASER
CAD FILE: BEE508-C-DWG-301.DWG

TITLE
McARTHUR RIVER MINE
EXPANSION PROJECT
LEVEE
SETOUT DETAILS

DRAWING SCALE	DWG SIZE	PROJECT No.
AS SHOWN	A1	BEE508

DRAWING No. BEE508-C-DWG-301

REVISION E



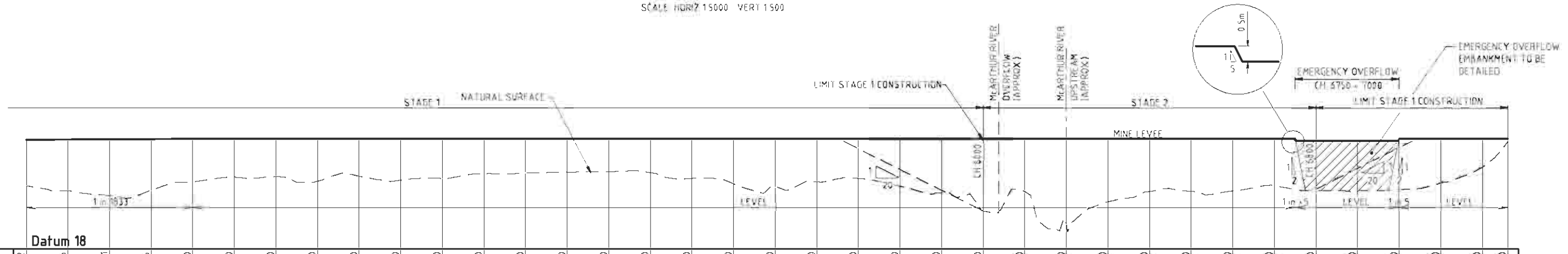
Datum 11

CHAINAGE	TOP OF LEVEE	NATURAL SURFACE	FILL DEPTH
0	44.200	42.880	-1.320
100	44.200	35.640	-8.560
200	44.200	33.346	-10.854
300	44.200	30.352	-13.848
400	44.200	28.527	-15.673
500	44.200	29.728	-14.472
600	44.200	32.514	-11.686
700	44.200	32.199	-12.001
800	44.200	32.738	-11.462
900	44.200	33.699	-10.501
1000	44.200	34.429	-9.771
1100	44.200	29.633	-14.567
1200	44.200	28.000	-16.200
1300	44.200	29.283	-14.917
1400	44.200	28.221	-15.979
1500	44.200	28.551	-15.649
1600	44.200	32.000	-12.200
1700	44.200	31.652	-12.548
1800	44.200	27.872	-15.828
1900	44.163	26.000	-18.163
2000	44.126	26.000	-18.126
2100	44.089	28.000	-16.089
2200	44.052	28.071	-15.981
2300	44.016	29.326	-14.69
2400	43.979	30.600	-13.379
2500	43.942	25.586	-17.355
2600	43.933	26.703	-17.230
2700	43.925	29.672	-14.253
2800	43.917	27.785	-16.132
2900	43.908	29.639	-14.270
3000	43.900	30.520	-13.380
3100	43.935	29.718	-14.217
3700	44.009	33.138	-10.872
3100	44.064	34.096	-9.968
3400	44.118	34.679	-9.439
3500	44.173	35.736	-8.437
3600	44.227	35.840	-8.387
3700	44.282	33.189	-11.093

TYPICAL SECTION: TYPE C | TYPE A | TYPE B | TYPE A

LEVEE (CH.0 - CH.3700)

SCALE HORIZ 1:5000 VERT 1:500



Datum 18

CHAINAGE	TOP OF LEVEE	NATURAL SURFACE	FILL DEPTH
3700	44.282	33.189	-11.093
3800	44.336	31.984	-12.352
3900	44.391	30.791	-13.600
4000	44.445	32.134	-12.311
4100	44.200	34.190	-10.010
4200	44.200	35.325	-8.875
4300	44.200	35.302	-8.898
4400	44.200	35.301	-8.899
4500	44.200	34.563	-9.637
4600	44.200	34.989	-9.211
4700	44.200	36.108	-8.092
4800	44.200	36.294	-7.906
4900	44.200	36.466	-7.734
5000	44.200	36.642	-7.558
5100	44.200	36.360	-7.840
5200	44.200	34.987	-9.213
5300	44.200	33.705	-10.495
5400	44.200	33.046	-11.154
5500	44.200	34.168	-10.032
5600	44.200	34.978	-9.222
5700	44.200	33.153	-11.047
5800	44.200	31.522	-12.678
5900	44.200	27.129	-17.071
6000	44.200	31.828	-12.372
6100	44.200	24.038	-20.162
6200	44.200	29.370	-14.830
6300	44.200	31.841	-12.359
6400	44.200	31.845	-12.355
6500	44.200	31.955	-12.245
6600	44.200	33.218	-10.982
6700	44.200	32.499	-11.701
6800	43.700	31.943	-11.757
6900	43.700	32.257	-11.443
7000	43.700	33.849	-9.851
7100	44.200	37.666	-6.534
7200	44.200	43.847	-0.353
7261	44.200		

TYPICAL SECTION: TYPE A | TYPE B | TYPE A

LEVEE (CH.3700 - CH.7261)

SCALE HORIZ 1:5000 VERT 1:500

xstrata

NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE
G	WATER CHANGES	31.08.06
F	WATER & UPS CHANGES	23.06.06
E	WATER CHANGES: NEW SPILLWAY ADDED	21.06.06
D	WATER & UPS CHANGES	04.04.06
C	STAGE LIMITS AMENDED	10.03.06
B	REVISED LEVEE ALIGNMENT	22.12.05
A	ISSUE FOR REVIEW	21.12.05

APPROVALS	NAME	SIGNATURE
DRAFTING	G.LEW	
DESIGN	G.CLOUGDALE	
DESIGN VERIFICATION	G.LEVELL	
PROJECT APPROVAL	G.VERESS	
CLIENT		

Kellogg Brown & Root Pty Ltd

KBR

Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
555 Coronation Drive, Toowong,
Brisbane, Queensland, 4066
ph (07) 3721-8599 Fax (07) 3721-8500

DRAWING SCALE: AS SHOWN | DWG. SIZE: A1 | PROJECT No.: BEE508

DRAFTER Y.FRASER CAD FILE BEE508-C-DWG-302.DWG

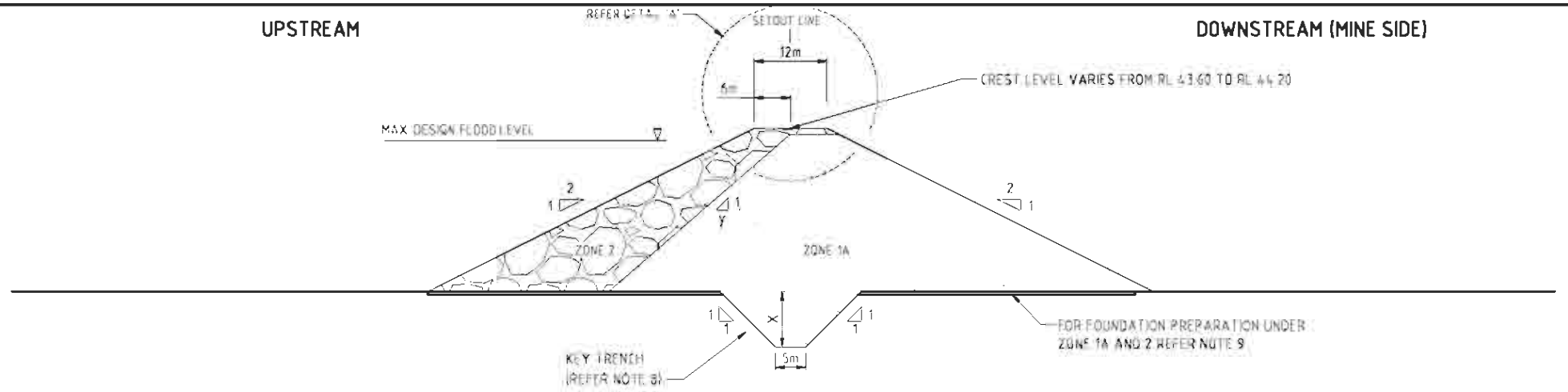
TITLE: McARTHUR RIVER MINE EXPANSION PROJECT
LEVEE
LONGITUDINAL SECTION - INITIAL CONSTRUCTION

DRAWING No.: BEE508-C-DWG-302

REVISION: G

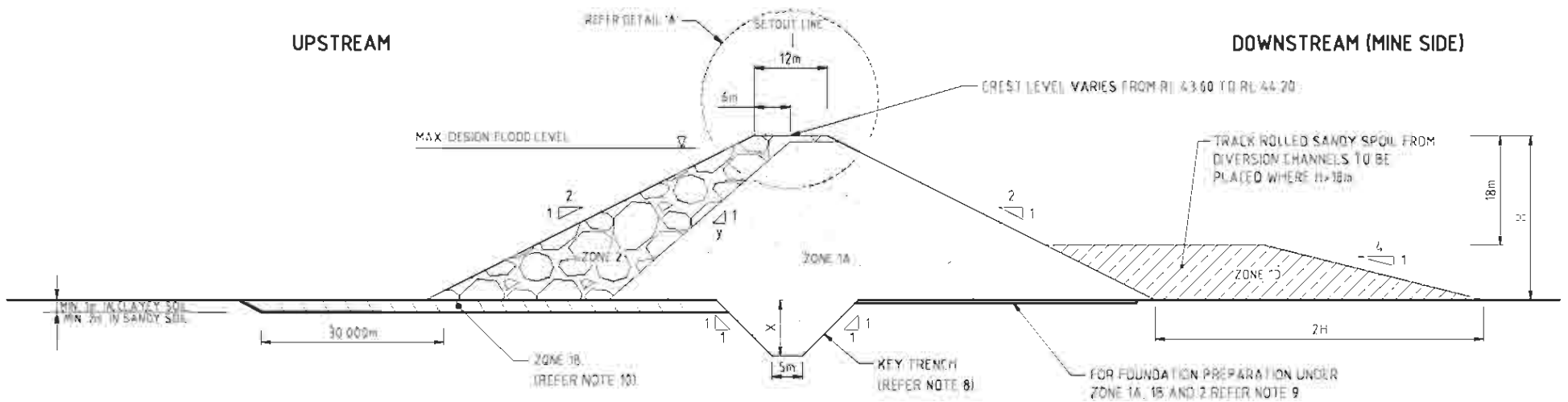
REFERENCE DRAWINGS: DRAWING No. | DESCRIPTION

NOTES: 100mm ON ORIGINAL DRAWING; SCALE 1:500; SCALE 1:5000



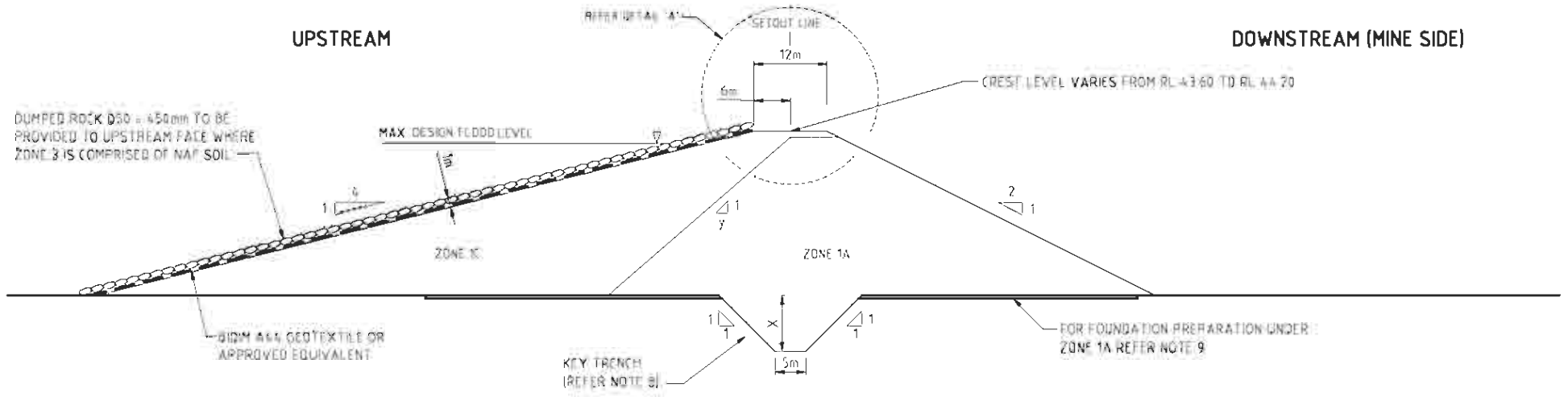
MINE LEVEE WALL TYPICAL SECTION A
(CH.1800 – 2500, CH.3200 – CH.5350 & CH.6650 – CH7261)

SCALE 1:500



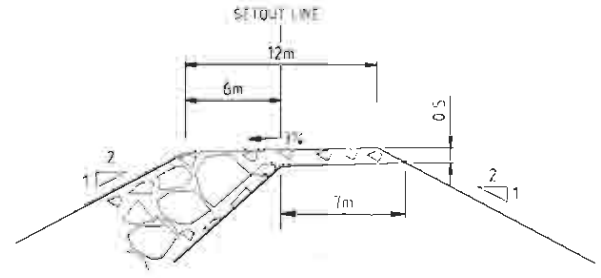
MINE LEVEE WALL TYPICAL SECTION B
(CH.2500 – 3200 & CH.5350 – 6650)

SCALE 1:500



MINE LEVEE WALL TYPICAL SECTION C
(CH.0.0 – CH1800)

SCALE 1:500



DETAIL A

NOT TO SCALE

NOTE:

1. THIS DRAWING IS BASED ON GOLDER ASSOCIATES FIGURE 16 - REV A2
2. ZONE 1A - EARTH FILL (EMBANKMENT)
   ZONE 1B - LOW PERMEABILITY EARTH FILL (BLANKET)
   ZONE 1C - RANDOM EARTH FILL
   ZONE 1D - SANDY FILL
   ZONE 2 - ROCK FILL (FROM CHANNEL EXCAVATION OR OPEN CUT MINE)
3. SITE PREPARATION OVER FOOTPRINT OF LEVEE SHALL COMPRISE STRIPPING OF EXISTING VEGETATION, ORGANICALLY CONTAMINATED SOIL & HEAVILY DESICCATED CLAYS (UP TO 0.5m DEPTH). SITE STRIPPING SHALL BE FOLLOWED BY PROOF ROLLING TO IDENTIFY LOCALISED SOFT SPOTS. SOFT SPOTS SHALL BE EXCAVATED & REPLACED WITH SELECT GRANULAR FILL.
4. 'y' = THE SLOPE OF THE SOIL BATTER MAY VARY LOCALLY DEPENDING ON MATERIAL AVAILABILITY. MAX SLOPE 1V:1H (SHOWN)
5. DESIGN BASED ON THE ASSUMPTION THAT ZONE 1A & 2 WILL BE PLACED SIMULTANEOUSLY SUCH THAT HEIGHT DIFFERENCE DOES NOT EXCEED 10m
6. AREAS UNDERLYING ZONES 1 & 2 ARE TO BE TOPSOIL STRIPPED TO 200mm NOMINAL DEPTH
7. SAFETY BERMS USED DURING CONSTRUCTION ARE TO BE RETAINED ON COMPLETION OF WORKS
8. KEY TRENCH TO BE CONSTRUCTED TO A MINIMUM DEPTH OF 1.0m BELOW STRIPPED SURFACE. WHERE SAND OR GRAVELS ARE INTERSECTED IN THE KEY TRENCH, THE KEY TRENCH SHALL BE INCREASED IN DEPTH TO INTERSECT LOW PERMEABILITY STRATA FOR MINIMUM DEPTH OF 0.5m. DEPTH TO BE CONFIRMED ON SITE BY SUPERINTENDENT.
9. PREPARATION OF ZONE 1A AND ZONE 2 FOUNDATION AREAS SHALL CONSIST OF IMPACT ROLLING THE STRIPPED SURFACE FOLLOWED BY MOISTURE CONDITIONING AND COMPACTION OF THE UPPER 200mm TO A 95% OF STANDARD MAXIMUM DRY DENSITY
10. WHERE CLAYEY SOILS (>35% PASSING 75 MICRONS) ARE ENCOUNTERED AT THE SURFACE, INSITU CLAYS SHALL COMPRISE THE CLAY BLANKET RE-COMPACTED TO A MINIMUM DEPTH OF 1.0m. WHERE SANDY SOILS ARE ENCOUNTERED AT THE SURFACE, A 2.0m MINIMUM THICKNESS CLAY BLANKET OF ZONE 1B MATERIAL SHALL BE USED.

xstrata

NOT FOR CONSTRUCTION

DRAW'G NO.	DESCRIPTION
REFERENCE DRAWINGS	

100mm ON ORIGINAL DRAWING

0 25 50 75 100 mm
SCALE OF METRES

NOTES

REV	DESCRIPTION	DATE
E	HATCH & URS CHANGES	22.06.06
D	HATCH CHANGES	23.05.06
C	HATCH & URS CHANGES	04.05.06
B	HATCH & URS CHANGES	04.04.06
A	ISSUE FOR REVIEW	21.12.05

REVISIONS

	NAME	SIGNATURE
DRAFTING	S.LINK	
DESIGN	G.THURLOW	
DESIGN VERIFICATION	G.LOVELL	
PROJECT APPROVAL	D.VENESS	
CLIENT		

APPROVALS

Kellogg Brown & Root Pty Ltd

KBR

Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
559 Coronation Drive, Toowong
Brisbane Queensland, 4066
ph (07) 3721-6555 fax (07) 3721-6500

DRAWING SCALE	DWG. SIZE	PROJECT No.
AS SHOWN	A1	BEE508

DRAFTER RJM CAD FILE BEE508-C-DWG-303.dgn

TITLE

McARTHUR RIVER MINE
EXPANSION PROJECT
MINE LEVEE WALL
TYPICAL SECTIONS - INITIAL CONSTRUCTION

DRAWING No. BEE508-C-DWG-303

REVISION E

O:\Projects\BEE508 - McArthur River Mine\TDS_Drawings\BEE508-C-DWG-303.dwg, 31/5/06 10:53

E616000

N8183000

E617000

N8183000

BARNEY CREEK DIVERSION

BARNEY CREEK

EXISTING BARNEY CREEK

LEVEE WALL CREST
RL 44.0

PROPOSED HAUL ROAD
TO OFF

SEDIMENT CONTROL DAM

ELECTRICAL
(OVERHEAD)

TEST PIT HAUL ROAD

TEST PIT
LEVEE

TEST PIT

TAILINGS PIPELINES
(ABOVE GROUND)

McARTHUR RIVER MINE BARNEY
HILL PROCESS PLANT

TAILINGS & ELECTRICITY
CONDUIT BENEATH HAUL ROAD

xstrata

BARNEY HILL TIE-IN CH 0.0

SCALE 1:2 000

NOT FOR CONSTRUCTION

100mm ON ORIGINAL DRAWING

40 0 40 80

SCALE 1:2000

REV	DESCRIPTION	DATE
E	MATCH & UNS CHANGES	12.04.06
D	MATCH CHANGES - TEST PIT LEVEE LABEL ADDED	23.03.06
C	MATCH & UNS CHANGES	06.04.06
B	HAUL ROAD ALIGNMENT AMENDED	16.03.06
A	ISSUE FOR REVIEW	27.12.05

	NAME	SIGNATURE
DRAFTING		
DESIGN		
DESIGN VERIFICATION		
PROJECT APPROVAL		
CLIENT		

DRAWING NO.	DESCRIPTION

REFERENCE DRAWINGS

NOTES

REVISIONS

APPROVALS

Kellogg Brown & Root Pty Ltd
KBR
Kellogg Brown & Root Pty Ltd ABN 91 002 844 810
555 Coronation Drive, Toowong
Brisbane Queensland 4066
ph (07) 3721-6555 fax (07) 3721-6900

DRAWING SCALE	DRWG. SIZE	PROJECT No.
AS SHOWN	A1	BEE508

DRAFTER

C:\0 FILE\BEE508-C-DWG-304.dwg

TITLE

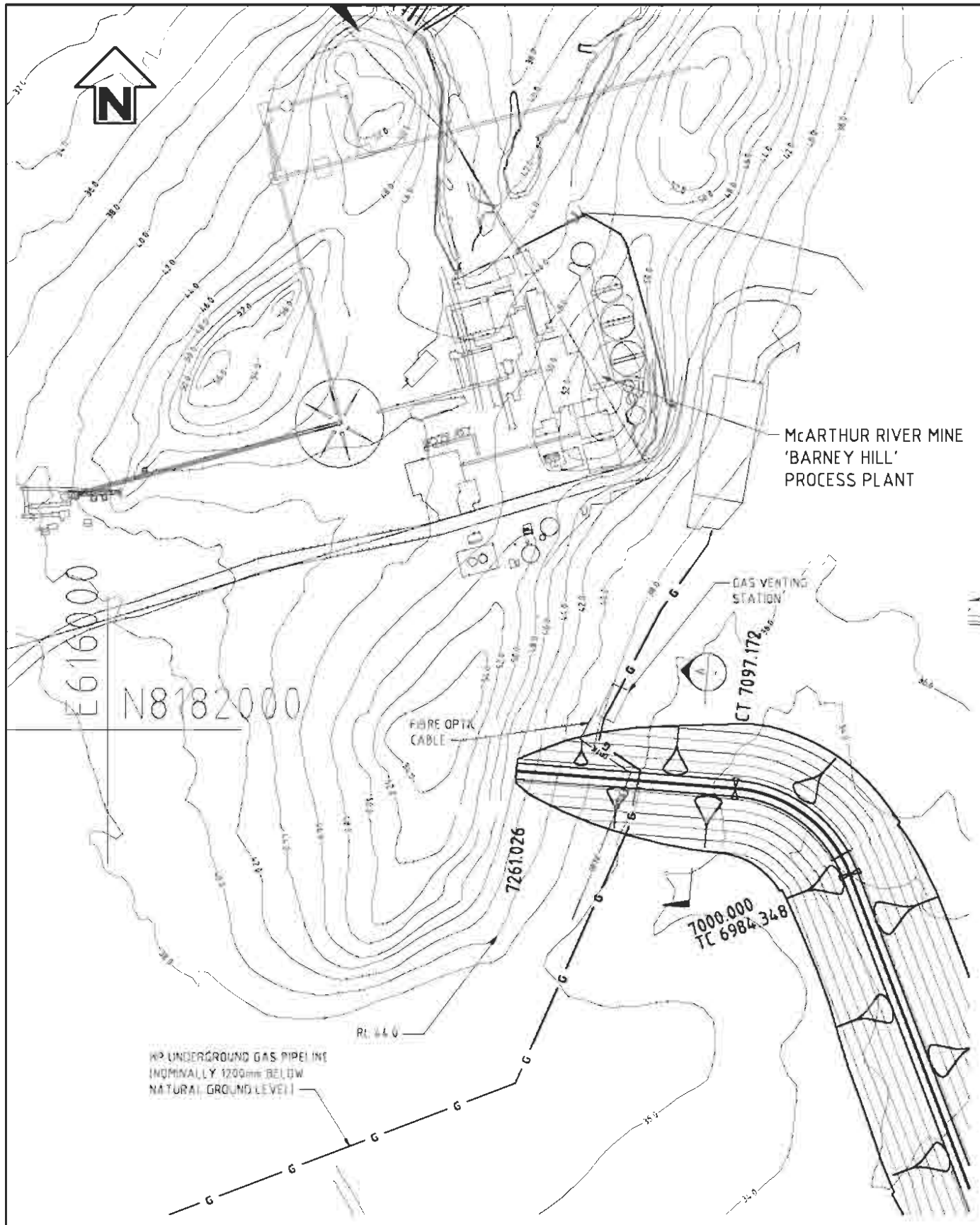
McARTHUR RIVER MINE
EXPANSION PROJECT
TIE-IN TO BARNEY HILL
AT CH 0.0

DRAWING No.

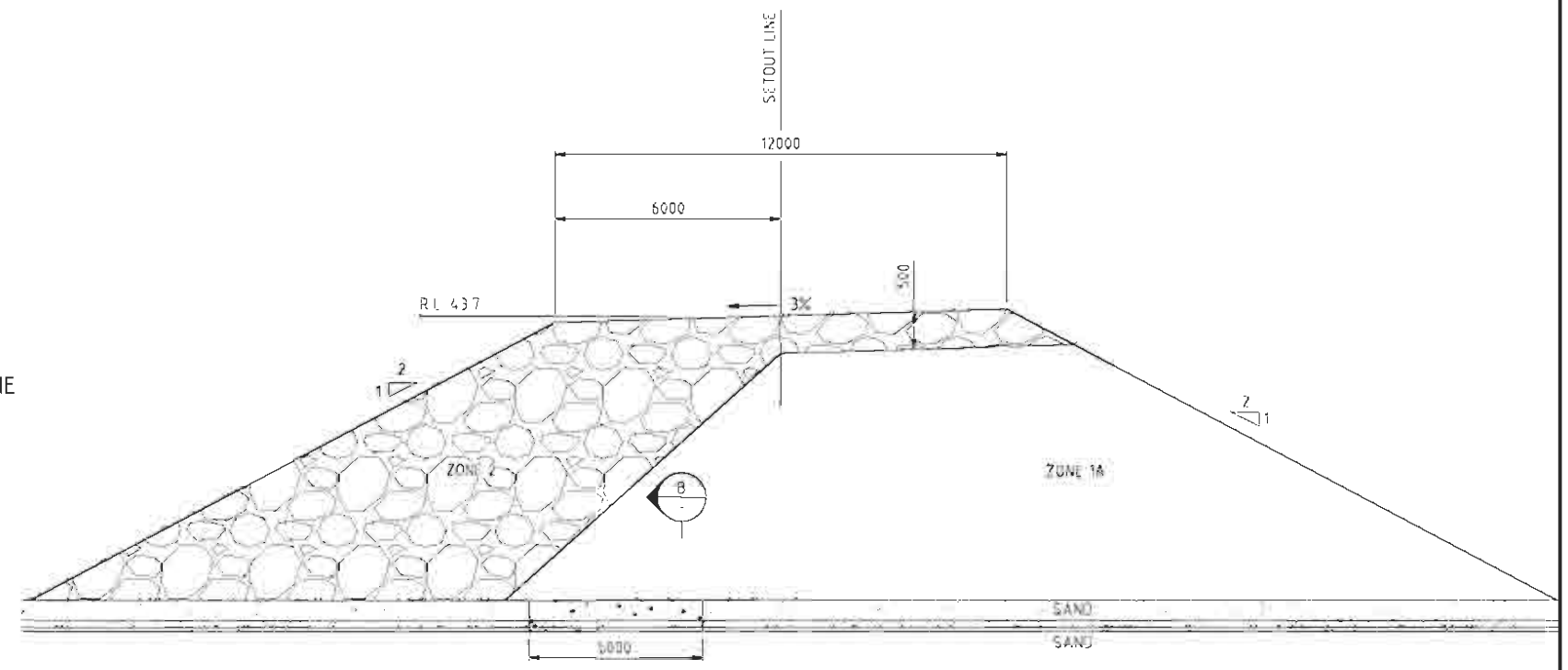
BEE508-C-DWG-304

REVISION

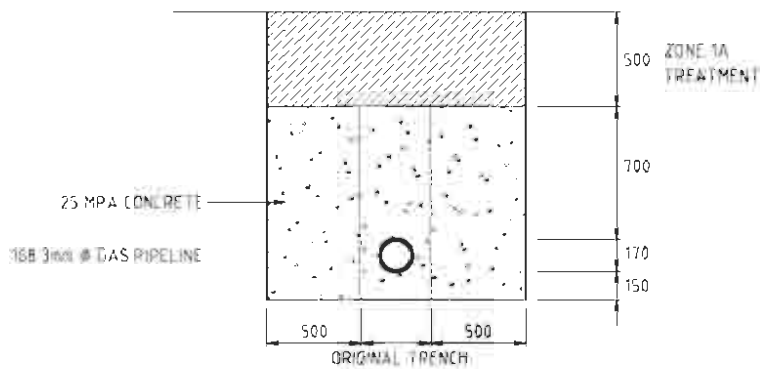
E



BARNEY HILL TIE-IN CH 7261
SCALE 1:2 000



SECTION A
SCALE 1:100



SECTION B
SCALE 1:20

NOTES:

1. FIBRE OPTIC CABLE TO BE RELOCATED BY OTHERS.
2. ALL LOCATIONS OF BURIED SERVICES TO BE CONFIRMED ON SITE PRIOR TO EXCAVATION.

NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE
G	MATCH CHANGES	30.04.06
F	MATCH & UKS CHANGES	20.04.06
E	MATCH CHANGES - FIBRE OPTIC CABLE NOTE AMENDED	03.04.06
D	MATCH & UPS CHANGES FIBRE OPTIC CABLE SHOWN	06.03.06
C	MATCH & UPS CHANGES	06.04.06
B	CHAINAGE UPDATED & ALIGNMENT REVISED	22.02.06
A	ISSUE FOR REVIEW	22.12.05

DRAFTING / DESIGN / DESIGN VERIFICATION / PROJECT APPROVAL / CLIENT — NAME / SIGNATURE

APPROVALS

DRAWING NO. / DESCRIPTION — REFERENCE DRAWINGS

NOTES

120mm ON ORIGINAL DRAWING
0 40 80m
SCALE 1:2000

Kellogg Brown & Root Pty Ltd
KBR
Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
555 Coronation Drive, Toowong,
Brisbane, Queensland, 4066
ph (07) 3721-6555 fax (07) 3721-6500

TITLE
McARTHUR RIVER MINE
EXPANSION PROJECT
TIE-IN TO BARNEY HILL
AT CH 7261

DRAWING SCALE	ORIG. SIZE	PROJECT No.
AS SHOWN	A1	BEE508

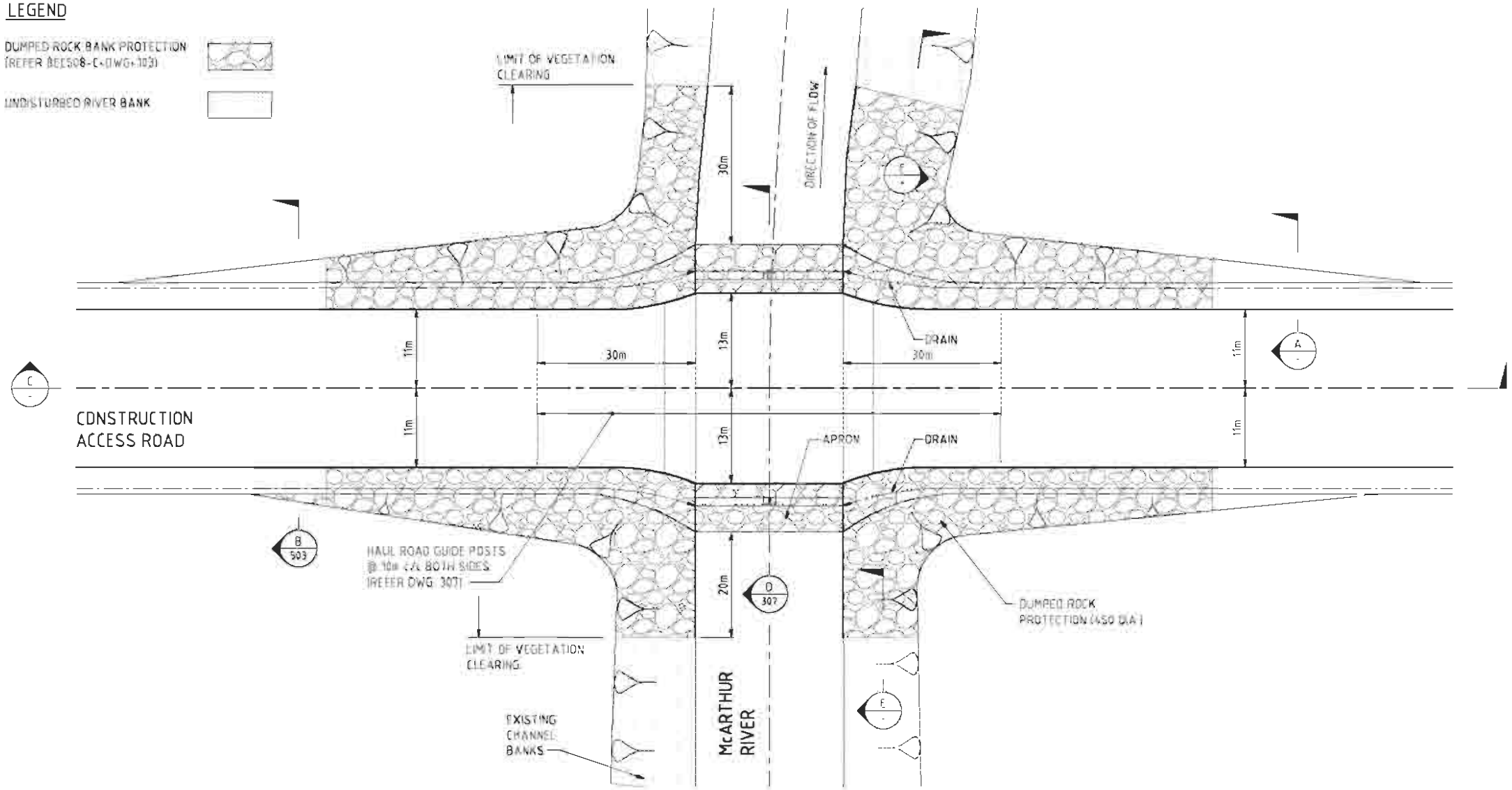
DRAWING No.: BEE508-C-DWG-305
REVISION: G

DRAFTER
CAD FILE: BEE508-C-DWG-305.dwg

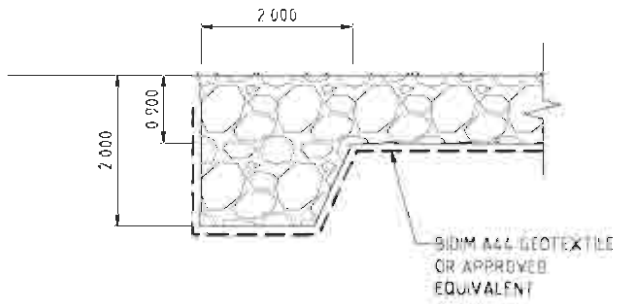
LEGEND

DUMPED ROCK BANK PROTECTION (REFER BEE508-C-DWG-303)

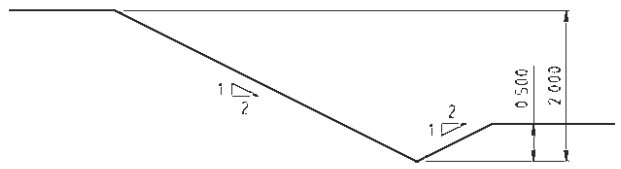
UNDISTURBED RIVER BANK



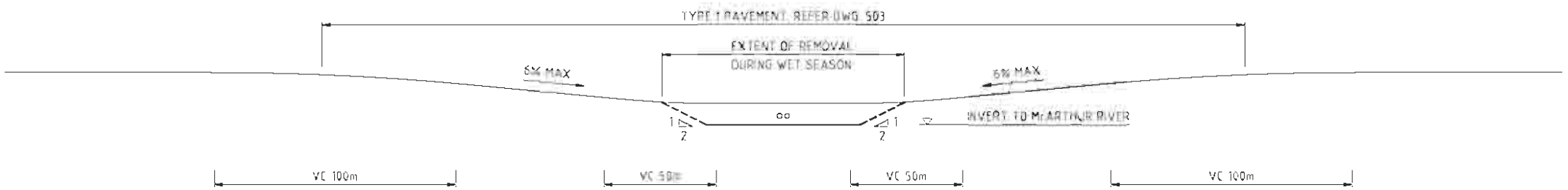
PLAN
SCALE 1:500



SECTION E
SCALE 1:50



SECTION A
SCALE 1:50



SECTION C
NOT TO SCALE

NOTE: THIS DRAWING HAS BEEN COMPILED FROM SKETCHES PROVIDED BY CONNELL HATCH

NOT FOR CONSTRUCTION

DRAWING NO.	DESCRIPTION

REFERENCE DRAWINGS

NOTES

REV	DESCRIPTION	DATE
E	MATCH CHANGES	21.06.06
D	MATCH & UPS CHANGES	16.05.06
C	MATCH & UPS CHANGES	04.04.06
B	NUMBER OF PIPES REDUCED & MATCHING ANNOTED	21.03.06
A	ISSUE FOR REVIEW	21.12.05

REVISIONS

	NAME	SIGNATURE
DRAFTING	S.LINK	
DESIGN	G.LOUGHLAN	
DESIGN VERIFICATION	G.LOVELL	
PROJECT APPROVAL	D.CHESS	
CLIENT		

APPROVALS

Kellogg Brown & Root Pty Ltd
KBR
Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
555 Coronation Drive Toowong
Brisbane Queensland 4066
ph: (07) 3721-6555 Fax (07) 3721-6500

TITLE
McARTHUR RIVER MINE
EXPANSION PROJECT
TEMPORARY RIVER CROSSINGS
SHEET 1 OF 2

DRAWING SCALE	DRWG. SIZE	PROJECT No.
AS SHOWN	A1	BEE508

DRAWN Y.FRASER CAD FILE BEE508-C-DWG-306.dwg

DRAWING No. BEE508-C-DWG-306

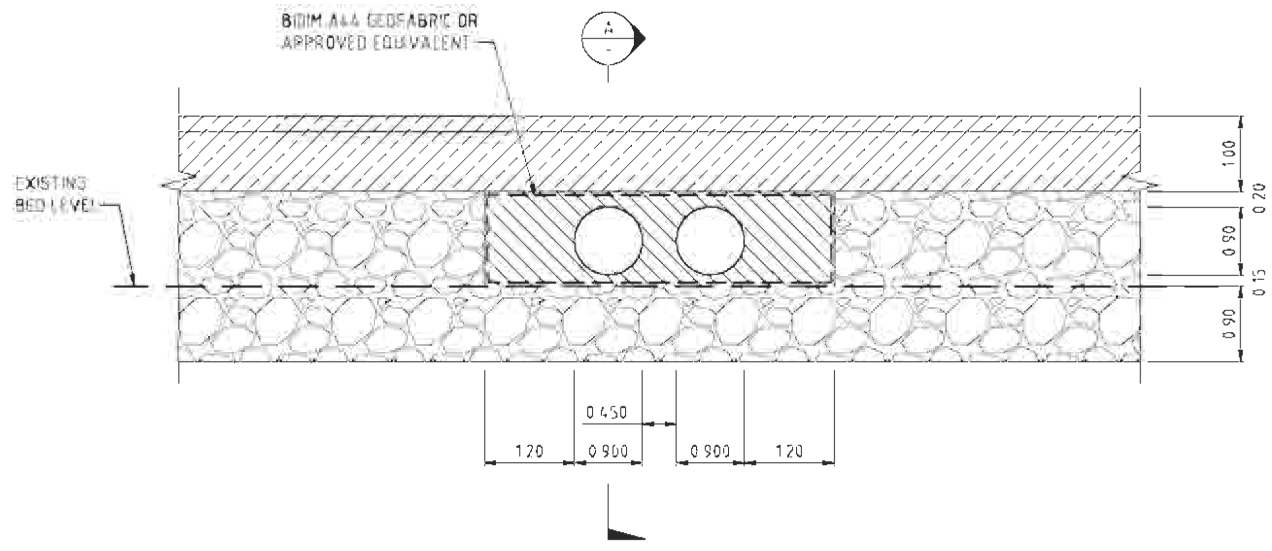
REVISION E

NOTES:

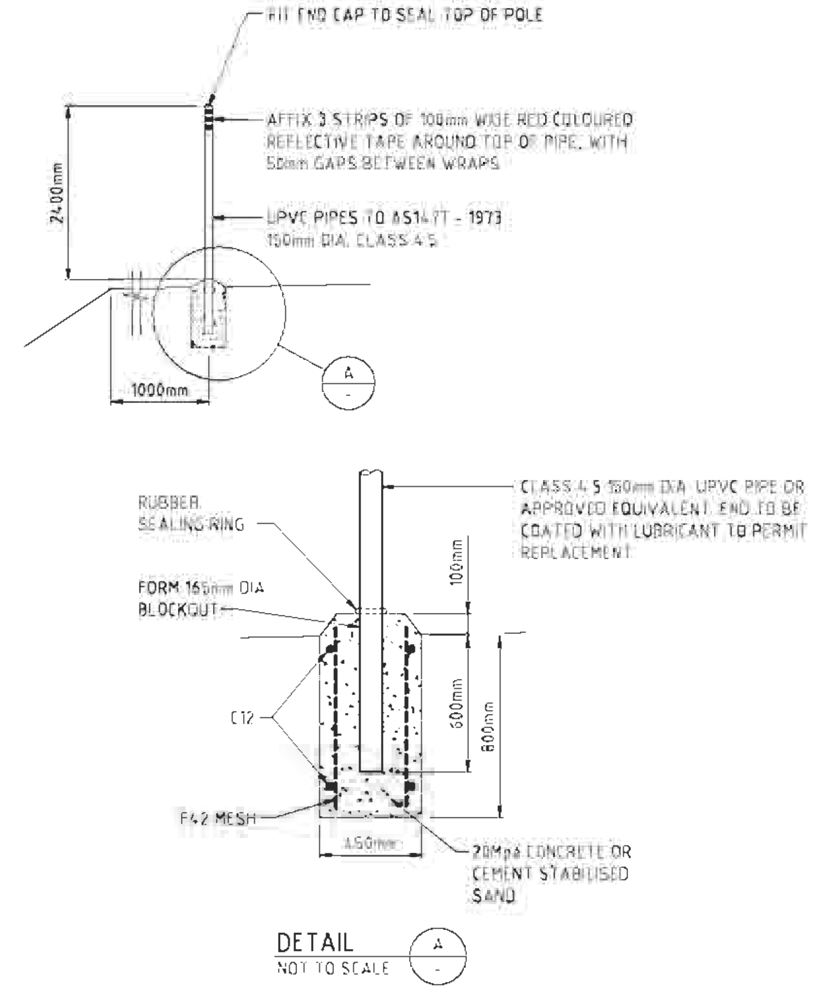
1. TEMPORARY RIVER CROSSING DESIGNED FOR CAT 777D HAUL TRUCKS
2. SELECT FILL AROUND PIPES IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS.
3. NOMINAL PIPE DIAMETER ADOPTED IN 900mm 16mm WALL THICKNESS INGAL HELCORE PIPE OR EQUIVALENT
4. SUGGESTED METHOD OF CONSTRUCTION
   - A STRIP, LEVEL AND COMPACT CHANNEL BED
   - B PLACE AND COMPACT ROCKFILL 2250mm DEEP
   - C CUT ROCKFILL FOR PIPES AND LAY GEOTEXTILE BIDIM A4 OR EQUIVALENT
   - D PLACE PIPES AND BACKFILL WILL SELECT FILL USING HAND COMPACTION EQUIPMENT
   - E PLACE AND COMPACT 100mm ROAD PAVEMENT MATERIAL
   - F PLACE GUIDE POSTS
5. TEMPORARY RIVER CROSSINGS TO BE REMOVED PRIOR TO COMMENCEMENT OF 2006 'WET SEASON'

LEGEND

- ROCK FILL, ø200mm MAX ROCK SIZE MACHINE COMPACTED IN 500mm THICK LAYERS
- SELECT FILL, ø40mm MAX. ROCK SIZE, HAND COMPACTED IN 150mm THICK LIFTS, CEMENT STABILIZED WITHIN 2m OF UPSTREAM & DOWNSTREAM
- PAVEMENT COMPRISING 200mm FRC, 800mm BASE (REFER DWG. 503)

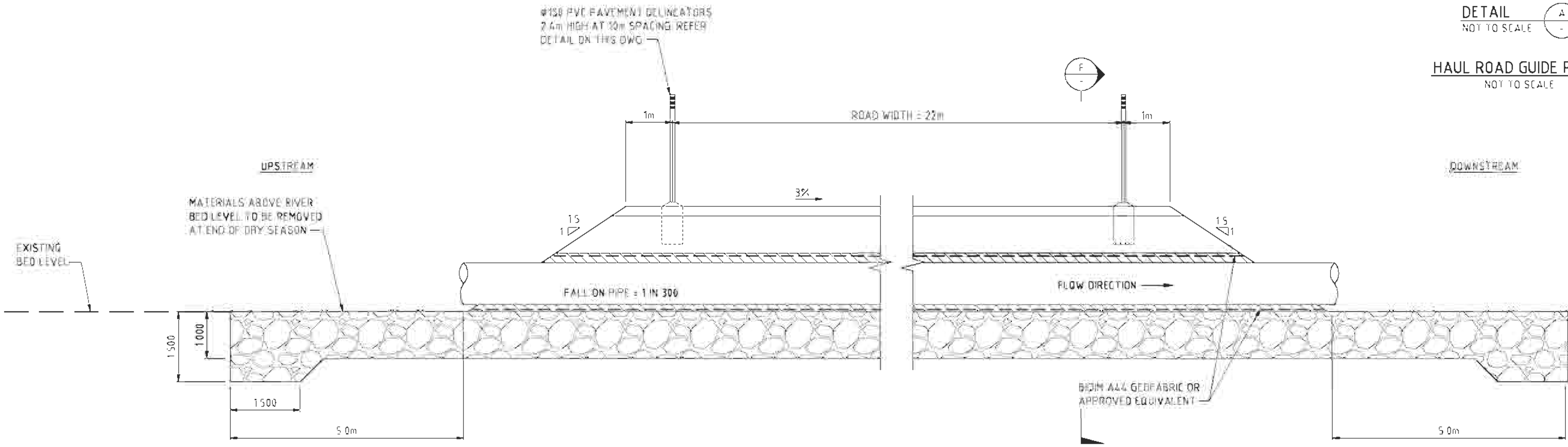


SECTION F
SCALE 1:50



DETAIL A
NOT TO SCALE

HAUL ROAD GUIDE POSTS
NOT TO SCALE



SECTION D
SCALE 1:50

xstrata

NOTE: THIS DRAWING HAS BEEN COMPILED FROM SKETCHES PROVIDED BY CONNELL HATCH

NOT FOR CONSTRUCTION

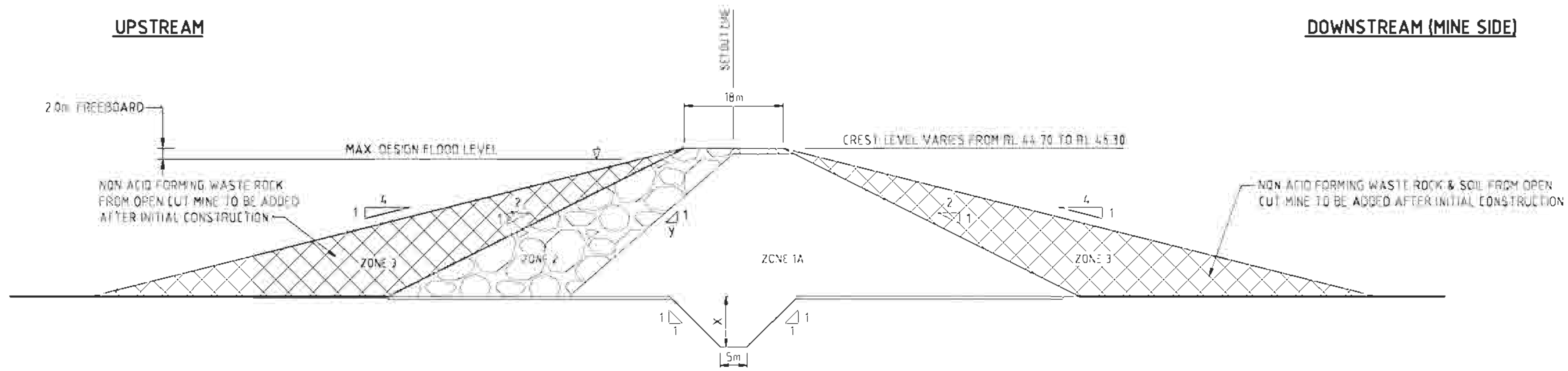
REV	DESCRIPTION	DATE
B	HATCH CHANGES - ROAD WIDTH AND PAVEMENT DEPTH	23.05.05
A	ISSUE FOR REVIEW	16.05.05

	NAME
DRAFTING	G. SPILLANE
DESIGN	GLOUDALE
DESIGN VERIFICATION	G.LOVELL
PROJECT APPROVAL	G.VEIWSS
CLIENT	

Kellogg Brown & Root Pty Ltd
KBR

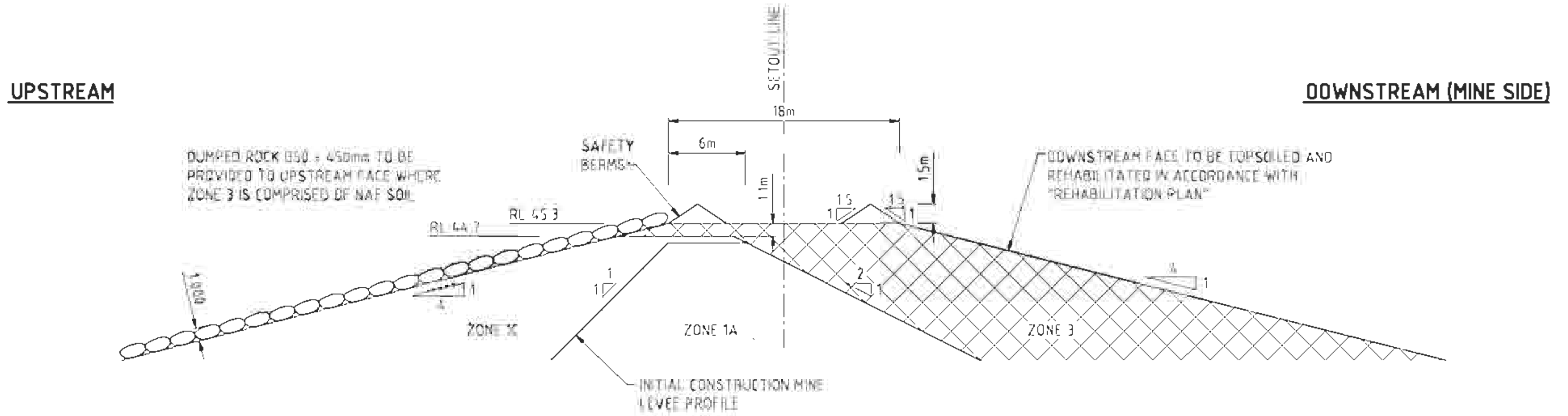
McARTHUR RIVER MINE
EXPANSION PROJECT
TEMPORARY RIVER CROSSINGS
SHEET 2 OF 2

DRAWING SCALE	ORIG. SIZE	PROJECT No.	DRAWING No.	REVISION
AS SHOWN	A1	BEE508	BEE508-C-DWG-307	B



MINE LEVEE WALL (CH 1800 - END)

DETAIL B
1:500



MINE LEVEE WALL (CH 0 - 1800)

DETAIL A
1:250

xstrata

NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE
C	HATCH & LINE CHANGES	23.06.08
B	HATCH CHANGES	23.05.08
A	ISSUE FOR REVIEW	01.05.08

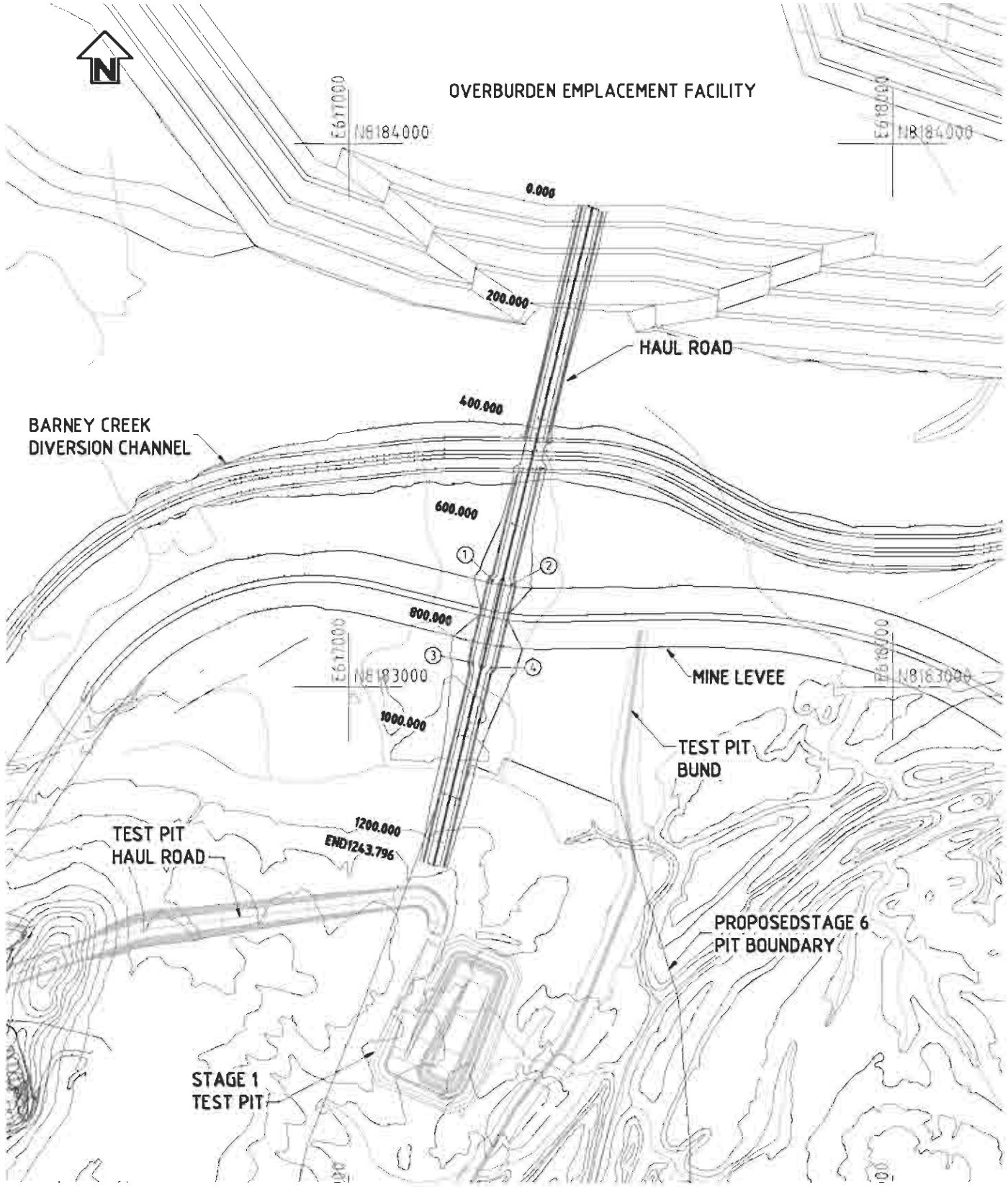
	NAME
DRAFTING	D.SPILLANE
DESIGN	D.DURRANT
DESIGN VERIFICATION	D.JOWELL
PROJECT APPROVAL	D.VENESS
CLIENT	

Kellogg Brown & Root Pty Ltd
KBR
Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
533 Coronation Drive, Toowong, Brisbane, Queensland, 4066
ph (07) 3721-6555 fax (07) 3721-6500

DRAWING SCALE: AS SHOWN | DWG. SIZE: A1 | PROJECT No.: BEES08

TITLE: McARTHUR RIVER MINE EXPANSION PROJECT MINE LEVEE WALL FINAL ARRANGEMENT

DRAWING No.: BEE508-C-DWG-308 | REVISION: C



LAYOUT PLAN
SCALE 1:5000

HAUL ROAD ALIGNMENT SETOUT

PT	CHAINAGE	EASTING	NORTHING	BEARING
IP1	0.000	7448.267	3880.620	193d34'56"
	200.000	7401.299	3886.213	193d34'56"
	400.000	7354.331	3419.806	193d34'56"
	600.000	7307.363	3297.399	193d34'56"
	800.000	7260.395	3702.993	193d34'56"
	1000.000	7213.427	2908.586	193d34'56"
	1200.000	7166.459	2714.179	193d34'56"
IP2	1243.796	7156.174	2671.608	193d34'56"

SAFETY BERM SETOUT

PT	CHAINAGE	EASTING	NORTHING
S1	709.500	7284.151	3195.189
S2	789.500	7299.144	3186.735
S3	865.500	7227.915	3043.651
S4	865.000	7262.509	3035.097

NOTE:

1 SURVEY DATUM
DATUM HORIZONTAL = MGM TRUNCATED
DATUM VERTICAL = AHD

2 ALL DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE PROJECT SPECIFICATIONS - BEE508-Z-SPEC-001

xstrata

NOT FOR CONSTRUCTION

100mm ON ORIGINAL @ A1
100 0 100 200
SCALE 1:5000

REV	DESCRIPTION	DATE
F	HATCH & URS CHANGES	07.06.06
E	DEP LAYOUT AMENDED	23.05.06
D	HATCH & URS CHANGES	04.04.06
C	BARNEY CREEK ALIGNMENT CHANGES	21.03.06
B	MINE LEVEE WALL AMENDED	16.02.06
A	ISSUE FOR REVIEW	21.12.05

APPROVALS	NAME	SIGNATURE
DRAFTING	S.LINK	
DESIGN	G.DOUGDALE	
DESIGN VERIFICATION	D.LOVELL	
PROJECT APPROVAL	D.VENESS	
CLIENT		

Kellogg Brown & Root Pty Ltd
KBR
Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
555 Coronation Drive, Toowong
Brisbane, Queensland, 4066
ph (07) 3721-6555 fax (07) 3721-6998

TITLE
McARTHUR RRIVER MINE
EXPANSION PROJECT
HAUL ROAD
SETOUT DETAILS

DRAWING SCALE	DRG. SIZE	PROJECT No.
AS SHOWN	A1	BEE508

DRAWING No. BEE508-C-DWG-501

REVISION F

DRAFTER Y.FRASER

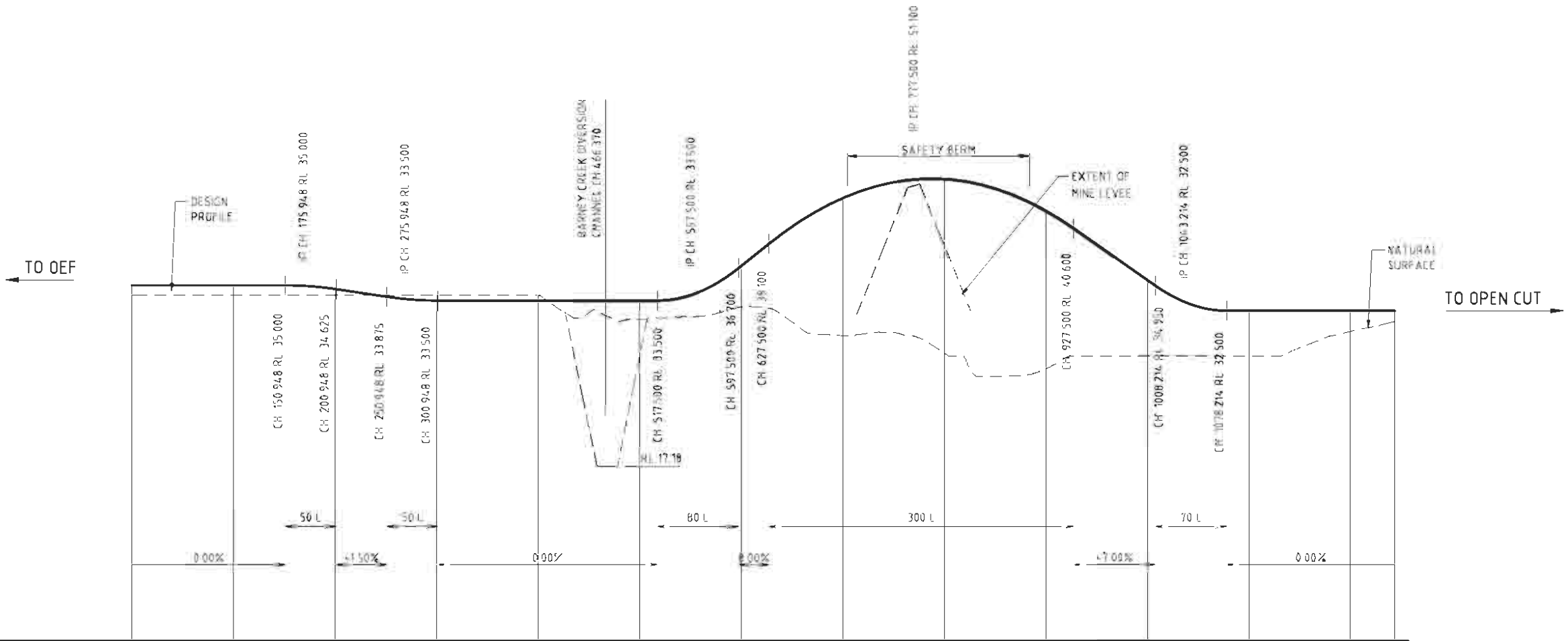
CAD FILE BEE508-C-DWG-501.DWG

REFERENCE DRAWINGS

NOTES

REVISIONS

O:\brc\Projects\Bee\BEE508 - McArthur River Mine\TDE_Drawings\BEE508-C-DWG-501.DWG 21.6.06 11:13



Datum 0

DEPTH TO EXISTING	-1 000	-1 000	-0 639	0 500	0 500	-1 873	-4 040	-13 547	-17 126	-15 547	-7 525	-4 500	-2 049	-1 052
DESIGN SURFACE	35 000	35 000	34 639	33 500	33 500	33 500	36 900	43 586	45 461	42 336	35 525	32 500	32 500	32 500
EXISTNG NATURAL SURFACE	34 000	34 000	34 000	34 000	34 000	31 627	32 860	30 039	28 335	26 789	28 000	28 000	30 451	31 448
CHAINAGE	0 000	100 000	200 000	300 000	400 000	500 000	600 000	700 000	800 000	900 000	1000 000	1100 000	1200 000	1243 796
	TYPE 1					BRIDGE								

HAUL ROAD LONGITUDINAL SECTION

SCALE HORIZ 12500 VERT 1250

xstrata

XREFS

DRAWING No.	DESCRIPTION

REFERENCE DRAWINGS

100mm ON ORIGINAL DRAWING

VERTICAL SCALE 1:250

HORIZONTAL SCALE 1:2500

NOTES

REV	DESCRIPTION	DATE
E	MATCH & URS CHANGES	27.06.06
D	MATCH & URS CHANGES	04.05.06
C	MATCH & URS CHANGES	06.04.06
B	PAVEMENT TYPES ADDED	21.02.06
A	ISSUE FOR REVIEW	21.12.05

REVISIONS

	NAME	SIGNATURE
DRAFTING	S.LINK	
DESIGN	G.RUGDALE	
DESIGN VERIFICATION	D.LOVELL	
PROJECT APPROVAL	D.VENESS	
CLIENT		

APPROVALS

Kellogg Brown & Root Pty Ltd

KBR

Kellogg Brown & Root Pty Ltd ABN 91 007 660 317
555 Coronation Drive, Toowong
Brisbane, Queensland, 4066
ph (61) 3721 6555 fax (61) 3721 6500

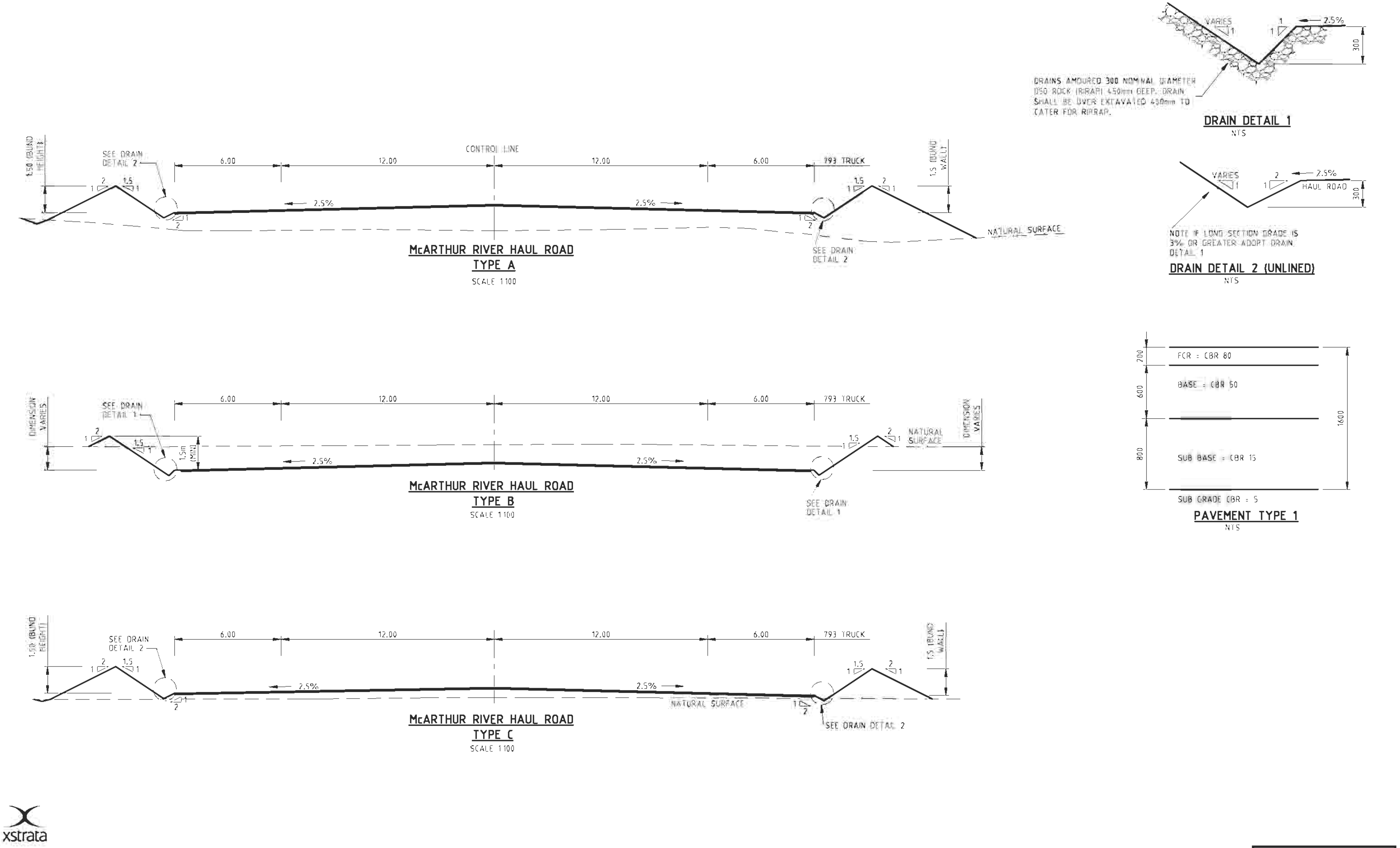
DRAWING SCALE: AS SHOWN
ORIG. SIZE: A1
PROJECT No.: BEE508
DRAFTER: T.FRASER
CAD FILE: BEE508-C-DWG-502.dwg

TITLE
McARTHUR RIVER MINE
EXPANSION PROJECT
BARNEY CREEK DIVERSION
LONGITUDINAL SECTION

DRAWING No.: BEE508C-DWG-502
REVISION: E

NOT FOR CONSTRUCTION

D:\Projects\Bee\BEE508 - McArthur River Mine\TDS_Drawings\BEE508-C-DWG-502.dwg, 22.6.06 10:11



DRAINS AMOURED 300 NOMINAL DIAMETER D50 ROCK (RIRAP) 450mm DEEP. DRAIN SHALL BE OVER EXCAVATED 450mm TO CATER FOR RIPRAP.
DRAIN DETAIL 1
NTS
NOTE IF LONG SECTION GRADE IS 3% OR GREATER ADOPT DRAIN DETAIL 1
DRAIN DETAIL 2 (UNLINED)
NTS
FCR : CBR 80
BASE : CBR 50
SUB BASE : CBR 15
SUB GRADE CBR : 5
PAVEMENT TYPE 1
NTS
CONTROL LINE
793 TRUCK
SEE DRAIN DETAIL 2
SEE DRAIN DETAIL 1
NATURAL SURFACE
McARTHUR RIVER HAUL ROAD
TYPE A
SCALE 1:100
McARTHUR RIVER HAUL ROAD
TYPE B
SCALE 1:100
McARTHUR RIVER HAUL ROAD
TYPE C
SCALE 1:100
xstrata

NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE
B	HATCH & ODS CHANGES	04.04.06
A	ISSUE FOR REVIEW	21.12.05

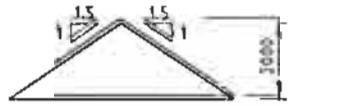
	NAME
DRAFTING	S.LIMP
DESIGN	O.GOODALE
DESIGN VERIFICATION	G.LOVELL
PROJECT APPROVAL	D.VANESS
CLIENT	

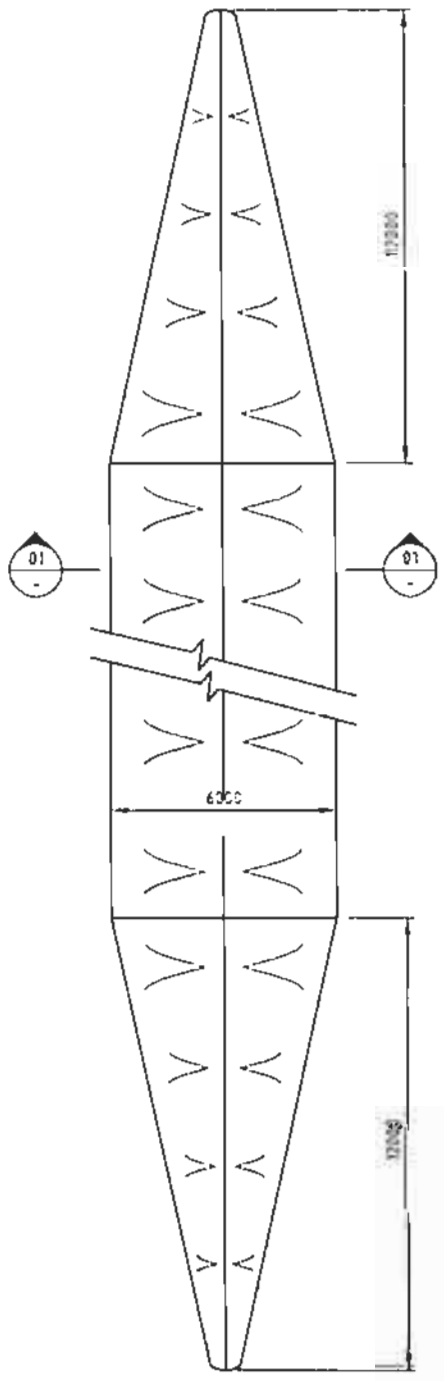
Kellogg Brown & Root Pty Ltd

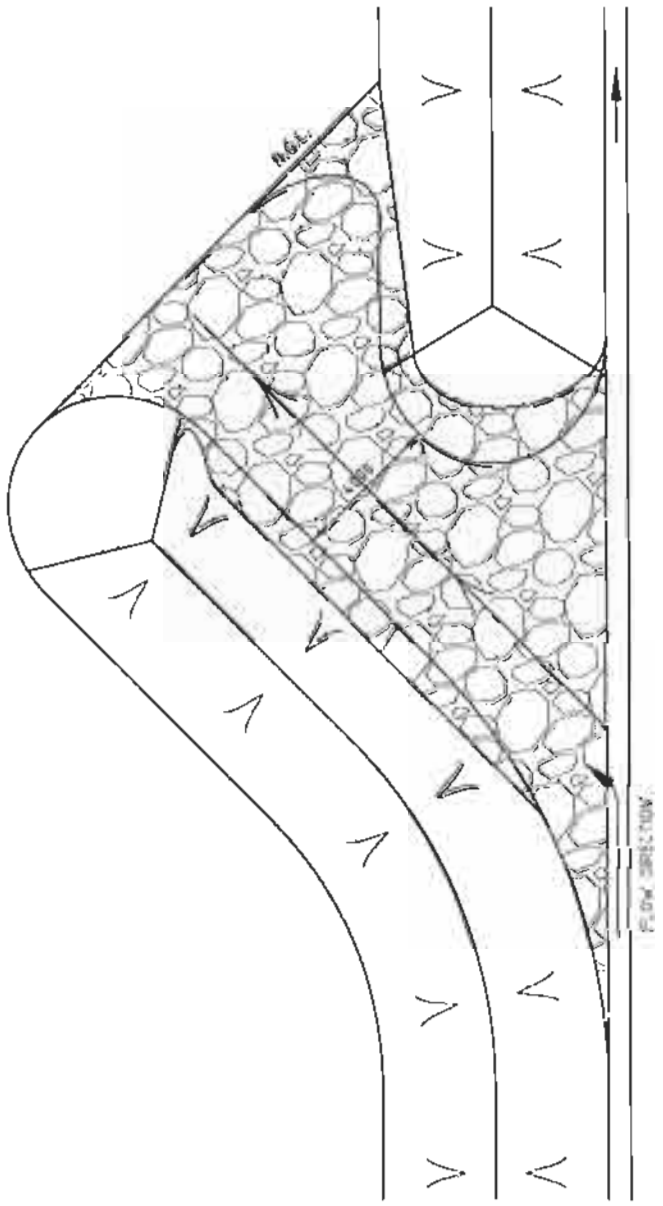
KBR

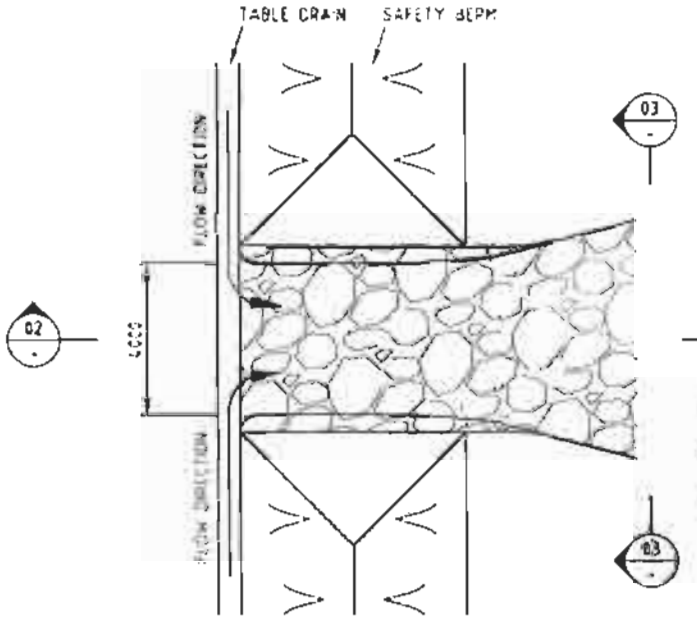
TITLE: McARTHUR RIVER MINE EXPANSION PROJECT TYPICAL HAUL ROAD SECTIONS - PAVEMENT DETAILS

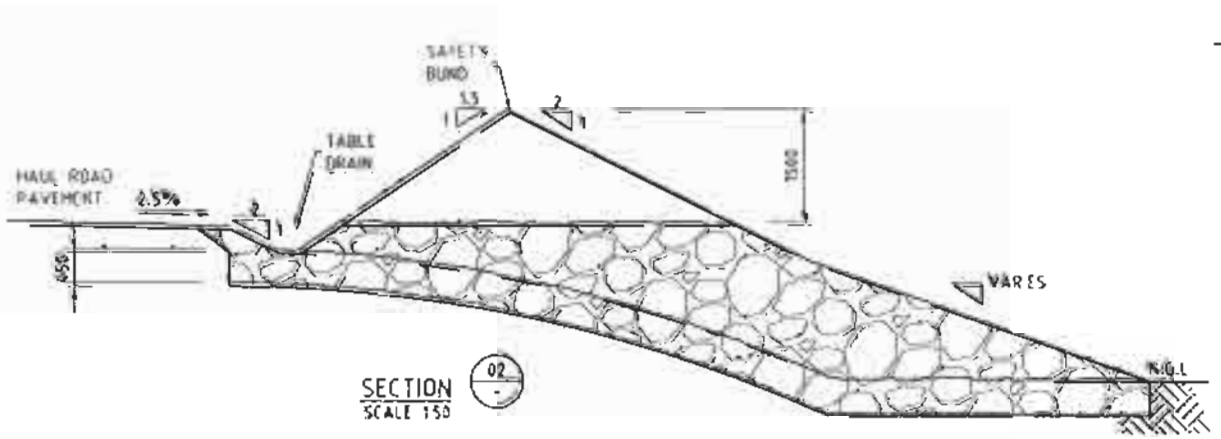
DRAWING SCALE	DWG. SIZE	PROJECT No.	DRAWING No.	REVISION
AS SHOWN	A1	BEE508	BEE508-C-DWG-503	B

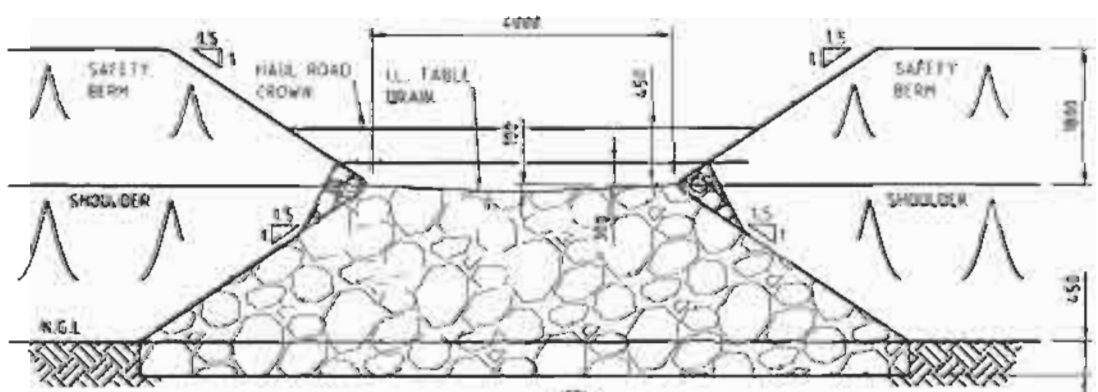












SECTION 01
SCALE 1:100

MEDIAN SAFETY BERM - PLAN
SCALE 1:100

PLAN
TABLE DRAIN OUTLET THROUGH
SAFETY BERM TYPE 2
SCALE 1:100

SECTION 02
SCALE 1:50

PLAN
TABLE DRAIN OUTLET THROUGH
SAFETY BERM TYPE 1
SCALE 1:100

NOTE
1.) DRAINAGE OUTFALLS @ 100m CENTRES OR AS NOTED ON PLAN.
2.) OUTFALL TREATMENT TYPE TO BE CONFIRMED ON SITE BY SUPERINTENDENT.
3.) DRAINS ARMOURED 300 NOMINAL DIAMETER D50 ROCK (RIPRAP) 450 mm DEEP. DRAIN SHALL BE OVER EXCAVATED 450mm TO CATER FOR RIPRAP.

SECTION 03
SCALE 1:50

xstrata

NOT FOR CONSTRUCTION

Kellogg Brown & Root Pty Ltd
KBR

TITLE
McARTHUR RIVER MINE
EXPANSION PROJECT
SAFETY BUND AND DRAINS DETAILS

DRAWING SCALE: AS SHOWN
DWG. SIZE: A1
PROJECT No.: BEES08
DRAWING No.: BEES08-C-DWG-S04
REVISION: A

Appendix C

Xstrata HSEC Standards

sustainable development

Health Safety Environment Community Management Standards

November 2004

Introduction

The Xstrata plc Board ('the Board') establishes the strategic direction of the Group which the Executive Management Team then implements. The Group operates a decentralised management model with authority delegated to Commodity Business Boards for Xstrata Alloys, Xstrata Coal, Xstrata Copper and Xstrata Zinc.

Commodity Businesses are given a high degree of autonomy to pursue their business objectives and they operate within the Group Policies governing inter alia:

- risk management;
- health, safety, environment and community; and
- corporate social involvement.

The Board has set the HSEC Policy for application across the whole Group and expects the Commodity Businesses and supporting functions to implement the HSEC Policy and HSEC Management Standards within the confines of what the Commodity Businesses consider reasonable and operationally viable.

Reference to directors, executives, managers, employees and contractors in the HSEC Standards is a reference to the respective directors, executives, management, employees and contractors in each Commodity Business.

Sustainable Development

Sustainable development is commonly described as the concept of balancing the needs of the present without compromising the ability of future generations to meet their own needs.[1]

[1] As defined by the UN World Commission on Environment and Development 1987

Table of Contents

1 Leadership, Accountability and Ethics 4
2 Planning, Resources, Objectives and Targets 5
3 Competency and Behaviour 6
4 Communication and Engagement 7
5 Risk and Change Management 8
6 Catastrophic Hazards 9
7 Legal Compliance and Document Control 10
8 Operational Integrity 11
9 Health and Occupational Hygiene 12
10 Biodiversity and Land Management 13
11 Contractors, Suppliers and Partners 14
12 Community 15
13 Project Management 16
14 Product Stewardship 17
15 Incident Management 18
16 Assessment and Reporting 19
17 Emergencies, Crises and Business Continuity 20

1 Leadership, Accountability and Ethics

Intent

Xstrata Directors, managers, employees and contractors demonstrate continuing commitment to excellence in HSEC management and ethical business practices.

Performance Requirements

1.1 Xstrata Directors shall understand and promote within their Commodity Business:

- Xstrata's HSEC policy and standards
- Ethical business practices
- Responsible environmental management
- Support for socio-economic development of the communities in which they operate
- Fundamental human rights

1.2 Xstrata Directors shall monitor HSEC regulatory compliance, performance, risks and strategic issues

1.3 Management shall demonstrate visible and proactive leadership and commitment to achieving HSEC excellence

1.4 Management shall be accountable for:

- HSEC performance of their Commodity Business
- Development, implementation and continuous improvement of HSEC management systems
- Meeting the performance requirements of these standards

1.5 Management shall allocate resources within their specified delegation for:

- Effective development, implementation and continual improvement of HSEC management systems
- Specialist HSEC advice when needed

1.6 Management shall be responsible for monitoring within their Commodity Business:

- HSEC performance
- Ethical business practices
- Responsible environmental management
- Support for socio-economic development of the communities in which they operate
- Adherence to fundamental human rights

1.7 All employees and contractors shall have the following arrangements, clearly defined, documented and communicated:

- Roles, responsibilities and accountabilities
- Authority to act
- Reporting relationships
- Specific and measurable HSEC performance indicators

The application and scope of these arrangements will be commensurate with their responsibilities and the hazards and risks to which they are exposed

2 Planning, Resources, Objectives and Targets

Intent

HSEC Strategy and annual HSEC Plans, together with achievable and measurable objectives and targets are an integral part of the Business Planning Process, leading to continuous improvement in HSEC performance.

Performance Requirements

2.1 A long term HSEC Strategy aligned to Xstrata's Group HSEC Policy shall be developed and implemented that will address:

- Sustainable development opportunities
- HSEC impacts of existing and new projects from exploration or plant construction through to closure
- Significant identified HSEC risks and opportunities
- Active engagement with local and indigenous communities

2.2 Annual HSEC plans aligned to the HSEC strategy and business objectives shall be developed in consultation with employees and implemented that will incorporate:

- Identified, significant HSEC risks and opportunities
- Allocation of human, physical and financial resources to achieve planned HSEC activities
- Clearly defined responsibilities
- Achievable and measurable objectives, targets and performance indicators for each relevant function and level within each Commodity Business

2.3 The HSEC Strategy and Annual HSEC Plans shall be documented and communicated to appropriate levels in the Commodity Business

2.4 The HSEC Strategy shall be monitored, reviewed and updated annually

2.5 The Annual HSEC Plans shall be reviewed at least quarterly to:

- Update when a change to business circumstances occurs
- Take remedial actions when deviation to plan occurs

2.6 The HSEC Plans shall consider and, where possible, generate sustainable development opportunities during the planning, designing, operational and closure phases of all operations

2.7 The Annual HSEC Plans will include a Closure Plan to be developed for all operations which shall include:

- An assessment of all operational and closure impacts
- Annually reviewed, fully costed, detailed closure plans designed to minimise impacts and risks
- Operational provisioning for the physical and financial resources require for closure

3 Competency and Behaviour

Intent

Employees and contractors have the appropriate levels of HSEC competence to perform their work activities, in accordance with Xstrata's HSEC Policies, Standards, Procedures and behavioural expectations.

Performance Requirements

3.1 HSEC competency shall be measured through the following requirements:

- Inclusion of OH&S and environmental awareness within selection and recruitment criteria
- An induction process that addresses Xstrata's HSEC requirements
- Identification of appropriate HSEC training needs for all positions
- Training in the HSEC management system
- Provision of appropriate competency based HSEC training
- Ongoing assessment of HSEC competence and delivery of refresher training as required

The application of these requirements shall be appropriate to the HSEC obligations, hazards and risks associated with the work activities

3.2 HSEC responsibilities shall be clearly documented as follows:

- Generic HSEC responsibilities in position descriptions
- Specific HSEC responsibilities in system procedures

3.3 Employees and contractors shall be made aware of their obligations to:

- Participate in the development and implementation of the HSEC management system
- Comply with defined HSEC policies and procedures
- Advise management of any changes to the work environment that may have an effect on HSEC

3.4 A behavioural management process shall be implemented that:

- Develops an understanding of the importance of a positive safety culture and human and behavioural factors in supporting safety improvement
- Identifies and corrects at-risk behaviours
- Identifies, commends and reinforces desired behaviours
- Captures behavioural data and information
- Analyses behavioural data and information to identify trends and results, improvement opportunities and critical safe and at-risk behaviours
- Seeks feedback on workplace HSEC: issues, management systems, and improvement suggestions

4 Communication and Engagement

Intent

Communicate and consult effectively with stakeholders, and engage them in HSEC matters through equitable and culturally appropriate means.

Performance Requirements

4.1 Employees shall be consulted with regard to, and encouraged to participate in, the development, implementation and review of HSEC requirements where appropriate

4.2 Effective channels of communication shall exist to communicate the following to all employees and relevant stakeholders:

- HSEC requirements
- Changes to HSEC requirements
- Information on HSEC performance, risks and other HSEC matters

4.3 A complaints management process shall be implemented that includes:

- Acknowledgement of the complaint
- A register of complaints
- Investigation of the complaint, if appropriate
- Implementation of corrective actions
- Reporting to relevant stakeholders the outcomes of investigations and subsequent corrective actions

4.4 A conflict resolution process shall be developed and implemented that utilises participative and consultative mechanisms

4.5 Equitable and culturally appropriate processes shall be in place to engage stakeholders in respect of their HSEC concerns and expectations

4.6 Relevant HSEC experience and knowledge shall be shared across Xstrata sites and stakeholders, including evolving information on metals and minerals and their life cycle effects on human health and the environment

4.7 Communication and consultation with governments, authorities and relevant organisations shall be in place to jointly improve and develop public HSEC policy, legislation and education focussing on sustainable development practices

5 Risk and Change Management

Intent

HSEC hazards and aspects associated with Xstrata operations, including planned and unplanned changes, are identified, risk assessed and eliminated or controlled. Catastrophic Hazards are specifically covered in Standard 6.

Performance Requirements

5.1 HSEC risk management process shall drive continual improvement in HSEC performance through:

- Systematic identification of HSEC hazards and aspects by competent persons
- Assessment of risks using recognised criteria and measures
- Prioritisation of the risks and their subsequent recording in a 'Risk Register', reviewed at least annually
- Implementation of controls in accordance with a 'hierarchy of controls'
- Review of the effectiveness of implemented controls
- Communicating to relevant parties information on identified hazards and controls and why particular actions are required
- Developing and implementing recovery plans

5.2 HSEC risk management process applies as a minimum to:

- Site operations
- Capital projects
- Plant and equipment
- Closed operations and operations under care and maintenance
- Mergers, acquisitions and divestments

5.3 Documented procedures for HSEC risk management shall be developed, implemented, maintained and continually improved through periodic reviews

5.4 When planned or unplanned changes occur in relation to:

- Site operations and facilities
- Capital projects
- Plant, equipment and production processes
- Legislation, standards and codes

These changes must be managed by:

- The HSEC risk management process
- Communicating relevant information to those who may be affected by the change
- Providing suitable training to those affected by the change
- Updating all relevant documentation reflecting the change, e.g. procedures, as-built drawings etc

5.5 Appropriate residual risk transfer shall be established and monitored

6 Catastrophic Hazards

Intent

To ensure that the organisation has the culture, processes and structures to identify and manage potential health, safety and environmental catastrophic hazards over the life of its operations.

Performance Requirements

6.1 All operations shall develop and maintain a register of high-hazard activities. These hazards will be identified and assessed using systematic and rigorous processes that examine the following:

- Legislative requirements
- Work-area hazard registers
- Relevant records, e.g. incident and maintenance records
- Industry practice and experience
- Relevant published data
- Specialist and expert judgements

6.2 All high hazard activities shall be analysed by the operation and those that could result in catastrophic consequences will be identified as catastrophic hazards

6.3 Catastrophic hazards registers and plans shall be developed for each operation. From this information a business inventory will be maintained

6.4 Executive Management teams of each Commodity Business will maintain and support a risk management culture by:

- Endorsing the catastrophic hazard management requirements
- Attending catastrophic hazard education and briefing sessions
- Reviewing and responding to recommendations and actions emanating from the HSEC assurance programme
- Committing the organisation to the enduring task of better anticipating, understanding and controlling catastrophic hazards

6.5 Internal and external communication processes will be established to allow those directly exposed to and others who have a legitimate interest in the hazard, to:

- Understand how the hazards were identified
- Understand why particular actions are required
- Receive communication and training as required

6.6 The status of catastrophic hazard registers, nominated risk control measures and other factors impacting on controls shall be monitored and include:

- Physical testing of the technical, warning and recovery aspects of the employed controls
- Individual and group consultation
- Reviewing internal and external incidents and applicable internal and external technical information
- Testing programmes
- Observation and inspections

7 Legal Compliance and Document Control

Intent

All relevant laws, regulations, standards, codes and Xstrata HSEC performance requirements are complied with, through an effective HSEC management system that includes document and data control.

Performance Requirements

7.1 Systems and procedures shall be implemented to ensure legal compliance through:

- Identification of all relevant HSEC legislation, standards and codes applicable to Xstrata's operations
- Creating an accessible register of the identified documents
- Identification of changes to all relevant HSEC legislation, standards and codes applicable to Xstrata's operations
- Communication to all employees of new and amended legislation, standards and codes that would affect their accountabilities
- Incorporation of legal requirements into the HSEC management system
- Monitoring and reporting

7.2 HSEC reference material shall define the structure of the HSEC management system (i.e. policy, standards, procedures etc) and provide references to other related documentation

7.3 A HSEC document and data control procedure shall exist that controls:

- Relevant HSEC management system documentation through revisions and approvals
- Records of relevant legislation, standards and codes
- Inadvertent use of obsolete HSEC documentation

7.4 A procedure shall exist to ensure all essential HSEC records are:

- Identified
- Traceable to an activity, product or service
- Collated
- Properly maintained and stored
- Confidential, where required
- Readily accessible and retrievable
- Retained for specified periods
- Disposed in a timely and proper manner
- Periodically archived

8 Operational Integrity

Intent

Operational integrity of plant and equipment is ensured, and the HSEC risks associated with operational and maintenance activities are managed.

Performance Requirements

8.1 Documented procedures shall be developed, implemented, maintained and reviewed, covering:

- Operational activities
- Plant and equipment
- Critical equipment
- Protective systems

8.2 Operational integrity shall be achieved through:

- Implementing appropriate safe-work procedures and permit to work systems
- Competent operations and maintenance personnel
- Documenting design parameters of plant and equipment
- Monitoring and reviewing design parameters as applicable
- Plant and equipment operators competently working within design parameters
- Sourcing specialist advice as required

8.3 Integrity of plant and equipment shall be achieved through:

- Maintenance, inspection, testing and calibration, including their associated instrumentation and control systems
- The rigour of maintenance, inspection and testing activities appropriate to the associated HSEC risks
- Timely availability, quality and suitability of consumables and replacement parts

8.4 Integrity of critical equipment shall be achieved through:

- Identification and recording of all critical equipment
- Inspection and testing prior to commissioning new, or re-introduced, critical equipment

8.5 Integrity of protective systems shall be achieved through:

- Reviewing the effectiveness of inspection, testing and maintenance procedures
- Appropriate rigour of inspection, testing and maintenance activities to the associated HSEC risks

9 Health and Occupational Hygiene

Intent

To identify, assess and control occupational health hazards through practical and reasonable measures to, where practicable, eliminate work-related illnesses and injuries.

Performance Requirements

9.1 Occupational health assessment and surveillance shall include:

- Assessments of fitness for work during pre-employment selection
- Regular health surveillance appropriate to the risk exposure
- Communication of the results of health assessments and surveillance with due regard for confidentiality

9.2 Occupational health and hygiene programmes shall include:

- Identification of occupational health and hygiene hazards including those associated with living in other countries and work-related travel
- Assessment of exposure to the hazards with reference to internationally recognised monitoring standards
- Implementation of controls to eliminate or minimise exposure to the hazards
- Provision of personal protective equipment where controls do not effectively reduce the risk exposure
- Targets set to drive improvements in occupational health and hygiene

9.3 An effective illness and injury management system shall be implemented that:

- Considers the location and nature of the operation/site to provide effective medical and first aid services
- Considers the physiological, psychological and sociological elements of injury or illness
- Ensures health care is administered under the guidance of properly qualified professionals
- Ensures rehabilitation systems and procedures promote early intervention to assist rapid recovery from work-related injuries or illness and an early return to work
- Takes all reasonably practicable steps to assist or provide rehabilitation and suitable duties to employees who are injured at work
- Maintains the injured person's position for as long as is reasonably practicable or as specified under relevant laws

9.4 The health and well-being of the workforce shall be promoted through access to health information and programmes

10 Biodiversity and Land Management

Intent

To develop and implement scientifically-sound technologies and procedures for the effective management and conservation of biodiversity and rehabilitation of disturbed land to a planned post-closure use.

Performance Requirements

10.1 Baseline studies shall be conducted at the feasibility or exploration phase of projects to:

- Establish existing conditions of biodiversity and land use
- Identify environmental risks
- Assess potential impacts
- Identify relevant standards

10.2 Environmental risk assessments associated with impacts on biodiversity and land use shall be undertaken for new operations or major changes to existing operations

10.3 Information acquired from 10.1 and 10.2 shall be used in the development of environmental management programmes in consultation with affected parties

10.4 Environmental management programmes shall be implemented, reviewed and remedial actions taken, if required, in relation to:

- Status of biodiversity
- Management methods
- Achievement of desired outcomes
- Land use management practices

10.5 The status of biodiversity shall be reviewed in terms of, but not limited to:

- Species and habitat loss or gains
- Factors that impact on biodiversity
- Security of protected areas
- Management of biological resources
- On-going rehabilitation and restoration of ecosystems
- Resilience of the ecosystem

10.6 Appropriate education and awareness of biodiversity and land management shall be provided to relevant personnel. Specialist advice will be sourced as required

10.7 Biodiversity considerations shall be addressed when determining post-closure land use and the rehabilitation or restoration of ecosystems as appropriate

10.8 All disturbed and contaminated land shall be progressively rehabilitated and wastes generated by operations shall be effectively managed to a planned post-closure land use

10.9 Scientific information on efficient biodiversity management, conservation and land use management, including developed technologies, shall be shared with stakeholders as appropriate

11 Contractors, Suppliers and Partners

Intent

Compliance with Xstrata's HSEC Policy and Standards through the systematic selection, engagement and management of contractors, suppliers and partners who provide Xstrata with products and /or services.

Performance Requirements

11.1 Contractors, suppliers and partners shall be selected based on defined criteria which include:

- A risk based HSEC evaluation of their products and/ or services
- An evaluation of past HSEC performance

11.2 Contractors, suppliers and partners shall be engaged through a formal contract or process that includes requirements for:

- Meeting or exceeding Xstrata's HSEC standards when carrying out activities on, or supplying to, an Xstrata operation or site
- Providing competent employees who are fit for work

11.3 Contractors, suppliers and partners shall comply with all relevant HSEC legislation, standards and codes

11.4 Contractors, suppliers and partners shall be managed through systems that include:

- Documentation of responsibilities and lines of communication
- Setting, monitoring and reporting on HSEC performance targets
- Monitoring and reporting on compliance with contractual HSEC obligations
- Feedback on their HSEC performance throughout the duration of the contract
- Consequences for non-compliance

11.5 Demonstrable processes shall exist to create business opportunities for local contractors, suppliers and partners that:

- Do not compromise Xstrata's HSEC standards
- Contribute to community development

12 Community

Intent

To identify key community risks and opportunities and manage those effectively to prevent adverse impacts, and deliver sustained benefits to the communities in which Xstrata operates.

Performance Requirements

12.1 Key community risks and opportunities shall be systematically identified with emphasis on:

- The most affected communities
- Projects and/or products with significant impacts

12.2 Identified community risks shall be prioritised through social impact assessments and mitigating community strategies shall be implemented to reduce the impacts

12.3 Community strategies, objectives and targets shall be periodically reviewed and actions taken where targets are not met

12.4 Employees with defined, documented, and communicated responsibilities for community related activities shall be appropriately skilled

12.5 Procedures shall exist to engage and interact with relevant communities through:

- Early engagement to manage issues of social impact
- Interaction, throughout the project's life-cycle, through equitable and culturally appropriate means

12.6 Local community social and economic well-being shall be improved where practicable through:

- Development and use of appropriate skills and technologies
- Support for community educational initiatives and health programmes
- Providing employment opportunities for local people
- Sourcing and purchasing from local companies
- Support for community projects
- Handling matters in a spirit of trust
- Promoting local business development

12.7 Respect for the rights of local communities shall be demonstrated through an understanding of:

- Traditional rights and cultural heritage of indigenous peoples
- Sensitivities involved in addressing issues of social impact
- Local laws and customs

12.8 Systems shall exist to measure and report on contributions made towards community development

13 Project Management

Intent

To effectively manage the HSEC risks throughout all project phases, i.e. exploration, pre-feasibility, conceptual design, detailed design, procurement, construction, commissioning, operation, decommissioning, closure and disposal.

Performance Requirements

13.1 HSEC risks of new developments shall be managed by processes that include:

- An appropriate level of baseline HSEC assessments prior to commencing exploration activities
- Pre-feasibility studies that identify fundamental impediments, undertake sufficient social and environmental assessments to determine risks, and develop commensurate risk management strategies that meet Xstrata, Commodity Business, statutory and stakeholder requirements

13.2 A documented project management system, relevant to HSEC risks, shall be used to deliver all projects and developments through:

- Formal evaluation(s) of the conceptual design against defined HSEC criteria, prior to management approval
- Formal evaluation(s) of the detailed design against defined HSEC criteria, prior to procurement or construction
- Identification of all foreseeable HSEC risks, constraints and opportunities relating to the project, and the effective management of these
- Compliance with Xstrata HSEC Standards and all relevant HSEC legislation, standards, and codes
- Applied experience from previous projects and current operations in appropriate context, to project development
- Site HSEC management systems to manage construction HSEC risks
- Design and construction that complies with sound engineering and technical standards
- Periodic project audits that monitor project milestones and outcomes
- Design, construction and operation that takes into consideration closure planning requirements
- A commissioning plan that addresses operability requirements and employee competency

13.3 HSEC risks of new plant, equipment, and infrastructure shall be effectively managed through procedures that:

- Identify, assess and control HSEC risks appropriate to the plant, equipment and infrastructure
- Evaluate and select plant, equipment and infrastructure against identified HSEC risks, and HSEC decommissioning, and disposal requirements
- Assess, prior to use, all newly installed plant and equipment against compliance with relevant design codes, standards and legislation

14 Product Stewardship

Intent

To minimise adverse HSEC impacts of Xstrata's operations and products and promote technologies that are efficient in energy, resources and materials usage.

Performance Requirements

14.1 Systems, processes and procedures shall exist to reduce the environmental impacts of Xstrata operations through:

- Ensuring wastes are eliminated, reduced, re-used, recycled, treated or properly disposed of
- The efficient use of energy, raw materials and natural resources
- Responsible product design and use, with focus on re-use and re-cycling as appropriate
- Appropriate handling, transport, use, storage and disposal of Xstrata products

14.2 The development and delivery of existing and new products and services shall include assessment of:

- Potential HSEC benefits
- Potential adverse HSEC impacts

14.3 All relevant employees, non-employees and customers shall be appropriately informed of the HSEC impacts associated with the handling, transport, use, storage and disposal of Xstrata products

14.4 Strategies shall be implemented that support research and innovation which promotes the use of safe and recyclable products and technologies that are efficient in the use of energy, natural resources and materials

14.5 Systems and procedures shall exist to identify, evaluate and respond to changes in external HSEC requirements that have potential impacts on Xstrata's products and/or operations, e.g. customer requirements, regulations, etc

15 Incident Management

Intent

To investigate, respond to and take appropriate corrective and preventative action following a HSEC incident.

Performance Requirements

15.1 Systems shall be developed and implemented to manage HSEC incidents that include:

- Immediate response to incidents
- Recording, classifying and reporting of incidents
- Statutory notification as per relevant legislation
- Incident investigation conducted to a depth commensurate with the actual and/or potential consequence of the incident
- Establishing the direct and underlying causes and contributing factors
- Developing, implementing and monitoring the effectiveness of corrective and preventative actions
- Documentation and communication of procedural changes where required by investigation outcomes
- Lessons learnt from investigation outcomes are disseminated throughout relevant areas of the business
- Collation and analysis of incident and investigation data to identify trends for improvement

15.2 Xstrata plc Board shall be informed of all critical HSEC incidents

15.3 Commodity Business Boards or Executive Teams shall be provided with the following for all critical HSEC incidents:

- Notification of the incident
- Management of the incident
- Outcomes of the investigation
- Completion of corrective actions

15.4 Commodity Business Executive teams shall demonstrate their personal involvement in the management of critical HSEC incidents by a team member:

- Visiting the site of the incident
- Reviewing the investigation process and findings

16 Assessment and Reporting

Intent

To provide assurance that all operations meet the performance criteria defined by Xstrata's HSEC Standards and the goals and objectives of the organisation.

Performance Requirements

16.1 Assurance of performance against Xstrata's HSEC Standards shall be provided through annual HSEC Assurance audits, alternating between internal and external assessments

16.2 All operations shall carry out HSEC internal assessments every two years, using appropriately trained internal assessors independent of the operations

Consideration shall be given to varying the audit frequency where Best Practice processes and performance have been validated over consecutive audits

16.3 External HSEC assessments will be carried out at the operations every two years by appropriately trained:

- External assessors, or
- *A combination of independent Xstrata* personnel and external assessors

Consideration will be given to varying the audit frequency where Best Practice processes and performance has been validated over consecutive audits

16.4 The following shall be monitored, reviewed, assessed and updated:

- HSEC Strategy
- HSEC Plans
- HSEC Objectives and Targets

16.5 HSEC performance shall be appropriately reported up the organisational chain to the Xstrata plc Board through a consistent, documented reporting process which includes:

- Internal assessment results
- External assessment results
- HSEC objectives and targets

16.6 Xstrata's HSEC performance shall be documented and systems will be in place for external reporting which includes:

- Economic, social and environmental performance
- Contribution to sustainable development
- Contribution to community development
- Independent verification as required

16.7 Individual operations shall conduct their own HSEC inspections and audits at frequencies appropriate to their level of HSEC risks

16.8 Commodity Businesses shall conduct internal and external audits to comply with international management system standards such as ISO 14001, OHSAS 18001, etc. based on their business needs

17 Emergencies, Crises and Business Continuity

Intent

To ensure appropriate resources and effective emergency response, crisis management and business continuity plans are in place to manage site emergencies and business crises.

Performance Requirements

17.1 All foreseeable site emergencies shall be systematically identified and their HSEC impacts assessed, including those associated with activities adjacent to the site

17.2 A site emergency response plan shall be developed in consultation with external emergency agencies to mitigate the assessed HSEC impacts. This plan shall be:

- Documented with defined roles and responsibilities
- Communicated throughout the site
- Made accessible to everyone at site

17.3 All employees and non-employees shall be trained in the emergency response plan to understand:

- Their roles and responsibilities
- The use of emergency response resources

17.4 Resources required for the management of emergencies shall be allocated and their adequacy reviewed

17.5 Emergency response and crisis management plan exercises shall be conducted:

- At least annually and as scheduled
- With involvement from external emergency agencies, as appropriate

17.6 Lessons learnt from actual emergencies and emergency exercises shall be:

- Properly documented
- Used to review and amend existing plans and resources as required
- Shared amongst other Xstrata operations as appropriate

17.7 Site emergency response plans shall be aligned to a Commodity Business level Crisis Management Plan

17.8 A well defined process shall exist to escalate a site emergency to a Commodity Business Crisis, as required

17.9 Sites shall contribute to and have access to the Commodity Business Continuity Plan which is managed at the business level