STORMWATER INVESTIGATION

FOR THE
OAKLEIGH WEST MINING PIT REHABILITATION

LOCATED AT
URRY ROAD
ASHWELL

PREPARED FOR NEW HOPE GROUP
BY BORNHORST & WARD PTY LTD

Bornhorst & Ward Project No. **13119**

If you have any queries regarding this report please contact Kris Rensch

Revision	Date	Description	Author	Rev.	App.
A	May 2013	For Information	KR	BB	NR

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APPENDICES

1. INTRODUCTION

Bornhorst and Ward has been commissioned to undertake a Stormwater Investigation of the existing Oakleigh West mining pit, located adjacent Urry Road and Rosewood Marburg Road, Ashwell.

The purpose of this report is to undertake a desktop investigation into the stormwater characteristics of the existing site, including identification of external catchments flowing through the site, and provide recommendation of stabilisation measures of disturbed areas following filling works, to prevent transportation of sediment into downstream properties.

Recommendations of Erosion and Sediment Control measures are as per International Erosion Control Association (IECA) Best Practice Erosion & Sediment Control Guidelines, November 2008.

2. SITE CHARACTERISTICS

2.1 LOCATION

The former mine is located on the northern side of Urry Road, Ashwell. It is bound by an existing 'historical' rail line to the north, Rosewood Marburg Road to the east, Urry Road to the south and Keates Road to the west. The disturbance area associated with this work is the second stage of the mine rehabilitation. The western portion of the property, approximately 50%, has previously been backfilled and vegetated.

2.2 TOPOGRAPHY AND SITE DRAINAGE

Upon completion of backfill to the mining pit, the site will drain from north to south. There is an existing dam in the southern section of the disturbance area which will capture the majority of the runoff. Overflow from the dam will discharge into the existing Covers Gully crossing through the site. The western catchment of the disturbance area will discharge into the previously rehabilitated mine area, which is currently vegetated.

The proposed rehabilitation contours, completed by New Hope Group have been reviewed. Grades in the northern portion of the site range around 25%, with the placement of gullies matching existing gullies within the upstream catchments. The lower portions of the site are proposed to have grades ranging between 2.5 – 15.0%. A number of channels through the area have also been proposed. These contour and channel locations have been used as the basis for stormwater calculations and channel sizing.

Upstream catchments totalling approximately 30.6Ha drain into the site through a number of naturally formed gullies. There is an existing bund following the northern and eastern boundaries of the disturbance zone, which was constructed during the mining operations. This is currently preventing flow from the upstream catchment entering the site. Runoff from the upstream catchment is currently captured by dams formed by the bund, with overflows being directed east and south across the compound area to a drainage channel running parallel to Rosewood Marburg Road. It is proposed that this bund is removed following finalisation of the downstream areas.

3. STORMWATER QUANTITY ANALYSIS

To form the basis of the recommendations contained within this report and accompanying drawings, a catchment analysis has been undertaken to identify stormwater catchments within and external to the works area. Catchments have been determined based on existing and proposed rehabilitation contours provided by New Hope Group.

3.1 RUNOFF CALCULATIONS

The quantity of runoff from each catchment, during a 1 in 100 year event has been calculated as per the methods outlined in the Queensland Urban Drainage Manual for Rural Catchments. The time of concentration has been calculated based on the average between the Bransby Williams equation and the Modified Friend's equation. For the purposes of these calculations, Ipswich IFD data has been applied in accordance with Australian Rainfall and Runoff 1987. Detailed calculations can be reviewed in Appendix B.

It is to be noted that the flows to each catchment have been calculated at the catchment discharge location and areas include the sub-catchment area plus the area of catchments upstream. Catchment boundaries are indicated on the drawing C021 and C022 attached in Appendix A.

Table 1: Runoff Calculations

Catchment	Area (Ha) Draining to Catchment	Coefficient of Runoff (C_{10})	Time of Concentration (minutes)	Q_{100} Discharge (m^3/s)
1 (portion of)	7.08	0.70	8.0	4.60
2	8.94	0.70	8.0	5.80
3	38.27	0.70	17.0	18.42
4	12.01	0.70	15.0	6.28
5	62.31	0.70	33.0	22.10
6	9.35	0.70	7.0	6.36
7	14.75	0.70	23.0	6.21
8	2.72	0.70	5.0	2.07
9	12.27	0.70	15.0	6.23
10	29.31	0.70	32.0	10.55
11	8.82	0.70	8.0	5.72

3.2 CHANNEL CALCULATIONS

Based on the above quantities of runoff, a number of channel flow calculations have been completed using the Manning's Equation. Channels have been sized for the 1 in 100 year event to ensure sufficient long term conveyance of all stormwater flows. For simplicity of construction, the number of varying channel profiles has been limited. Velocities and flow depths have been checked for the steepest and flattest sections of each channel profile. Channels have been sized to minimise flow depths and also maintain velocities around or below 3.0m/s. A wider and slower passage of water will in turn protect against long term erosion.

Detailed calculations can be reviewed in Appendix A, and channel profiles and surface treatments are discussed in the following sections.

4. PROPOSED EROSION AND SEDIMENT CONTROL MEASURES

The following summarises the solutions proposed, as detailed by the Erosion and Sediment Control drawings attached in Appendix A.

4.1 CONTOUR BANKS

In order to direct surface runoff within the disturbed areas to the central drainage paths, contour banks are recommended to be constructed. These are typically bunds, 500mm deep constructed perpendicular to the fall of the land. These aid in preventing erosion, including surface rilling, caused by continual low flows.

IECA Best Practice Erosion & Sediment Control Guidelines recommend contour banks spacing should not exceed 80m, with bank spacing being calculated as per the following equation:

$$\text{Maximum Horizontal Spacing (m)} = 100/(\text{batter slope \%})^{0.64}$$

Contour Bank spacing has been calculated for each catchment, with maximum horizontal spacing per catchment being provided in the table on drawing C020 Erosion & Sediment Control Notes and Details attached in Appendix A. For the purposes of this exercise, bank spacing has been calculated based on a medium rainfall erosivity and low to moderately erodible soil. Periodical maintenance is required to remove sediment from the contour banks, once sediment builds up.

Following establishment of the area it is recommended that these contour banks remain, preventing re-disturbance. If however all areas are thickly vegetated, the contour banks could be removed from the flatter areas of the site, however contour banks in the northern portion, as identified by catchments 1, 2, 6 and 8 on drawing C021, are recommended to remain permanently.

4.2 ROCK LINED CHANNELS

A number of gullies in the northern steeper areas of the site (within catchments 1, 2, 6 and 8) have been proposed by the rehabilitation contours. These typically match the existing gullies entering the site from the upstream catchments. Channels have been sized for Q_{100} flow based on the runoff calculations completed above.

Given the proposed grade, stabilisation of these areas is recommended using a dumped rock lined channel. It is recommended that the rock consists of 150 – 300mm diameter shot rock, placed to form a channel with dimensions as noted on drawing C020 Erosion & Sediment Control Notes and Details. To prevent erosion beneath the rock, a geo textile layer should be placed. Edges of the geo textile should be buried to prevent water ingress beneath the channel.

Following establishment of the area it is recommended that these channels remain.

4.3 OVERLAND FLOW PATHS

Larger width overland flow paths have been proposed, generally in the flow paths indicated by the rehabilitation contours prepared by New Hope Group. As indicated in sections above, flows within these areas are expected to range between 10 and 20m^3/s during a 1 in 100 year rainfall event.

To direct runoff to the southern areas of the site, wide channel profiles are proposed, to aid in spreading the water to maintain low velocities and a shallow depth of flow. It is recommended that the channels are stabilised with stay turf to provide immediate protection against erosion.

Stay turf is soil free turf grown on an organic geotextile reinforced with plastic mesh. The benefit is immediate stabilisation of overland flow paths, preventing against erosion. It is recommended that this is installed as per manufacturers' guidelines, which includes pegging and overlaps. It is noted that the edges and upstream ends should be buried and overlaps should be facing downstream to prevent water flowing beneath the matting.

Following establishment of the area it is recommended that these channels remain, forming permanent Q_{100} flow paths within the site.

4.4 ROCK CHECK DAMS

To prevent transportation of sediment from contour banks downstream via the overland flow channels, it is recommended that rock check dams are provided within the main channel lines. These should be placed at the intersection of the contour banks and the main channel lines. As per the detail on drawing C020, these consist of dumped rock to provide a 300mm high bund within the channel line. Periodical maintenance is required to remove sediment from the check dams, once sediment reaches half the height of the check dam.

Upon stabilisation of upstream areas the rock check dams can be removed.

5. STAGING OF WORKS

It is recommended that the revegetation and final earthworks levels are staged, serving the following purpose:

- Providing manageable sections for completion of final levels and revegetation,
- Limiting the area of freely draining bare earth,
- Ensuring that the upstream, un-vegetated areas can discharge to stabilised portions of the site downstream,
- To provide stormwater catch ponds at the boundary of downstream completed and incomplete upstream areas, allowing runoff to pond and suspended particles to settle out prior to pump out.

On the above basis, a conceptual staging plan has been developed, refer Drawings C023- 024 attached in Appendix A. The staging plan has been set such that the lower portions of the site are completed first, in a west to east order. Once areas are at least 70% established, the next upstream stage can be completed. It is recommended that the uncompleted areas are locally left 1m low to the finished surface at the stage boundary, providing a Stormwater Catch Pond. Runoff from the un-stabilised earthworks area can discharge to this location and pond allowing sediments to settle. The stormwater can then be pumped from the catch pond into the downstream established stage. Refer to the staging detail provided on Drawing C023 attached in Appendix A.

To prevent inflow from upstream catchments it is recommended that the existing bund at the northern and eastern works boundary is left in place until all downstream areas are sufficiently established. Following this, the bunds can then be removed, with these areas being seeded, contour bunds installed and channels being extended to the existing vegetation line as necessary.

6. COMMENTARY ON WESTERN REVEGETATED AREA

The western portion of the mine has previously been backfilled and revegetated. Based on the site inspection, it was noted that thick grasses exist within the site, with all areas being satisfactorily stabilised. Some rilling was observed throughout the property, however given the large catchment extents this is to be expected. As the majority of the area is thickly vegetated it is not believed that this poses any issues.

Discussions occurred on site regarding the stability of the overland flow path crossing south west through the property. This was viewed from a number of vantage points within and surrounding the mine property. Aerial photography from May 2012 has been reviewed as per Figures 1 and 2 below.

As indicated by the aerial photography, there are slightly eroded portions of the site as a result of continual stormwater flow through the area. As discussed above during the site inspection, most areas appeared to be sufficiently stabilised and vegetated. It is recommended that a further detailed ground inspection be undertaken of the area. Should erosion and transportation of sediment be occurring through this area, it is recommended that the area is rectified as follows:

- Undertake survey to determine naturally formed channel extents.
- Clear area and form 20m wide overland flow path, as per Channel detail on accompanying drawings.
- Stabilise area with stay turf, installed as per manufacturers' specifications.
- Water and maintain area until turf is sufficiently established.

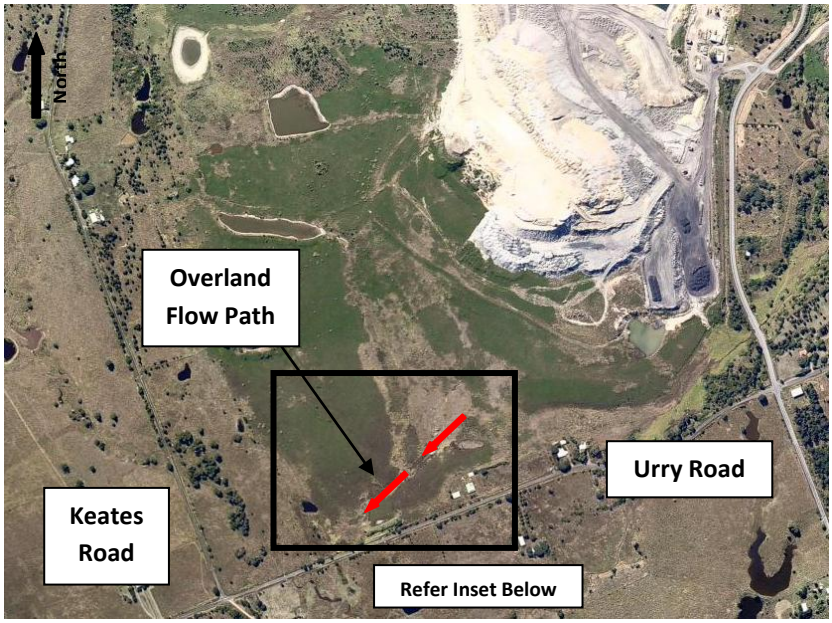


Figure 1: Aerial Photo

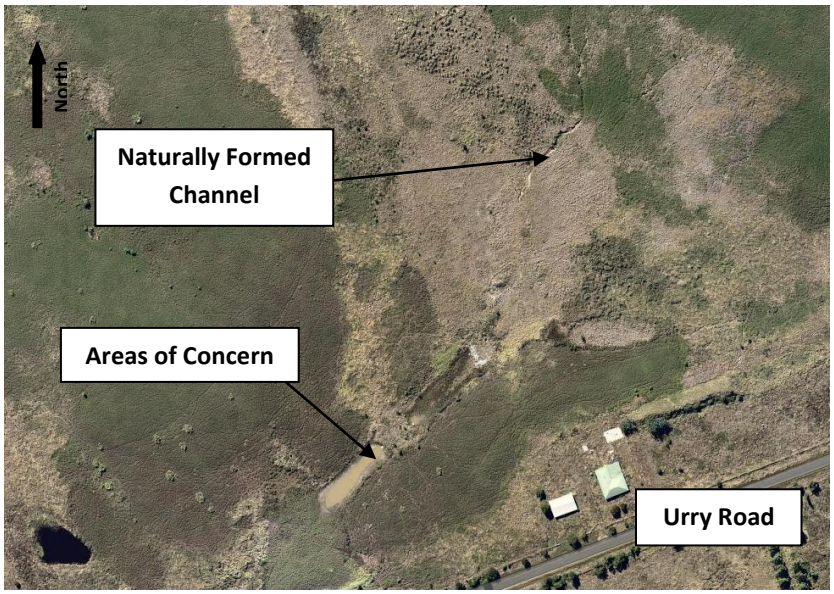


Figure 2: Inset (Refer Figure Above)

7. SUMMARY & RECOMMENDATIONS

Based on the site inspection and desktop investigation conducted the following conclusions and recommendations are put forward:

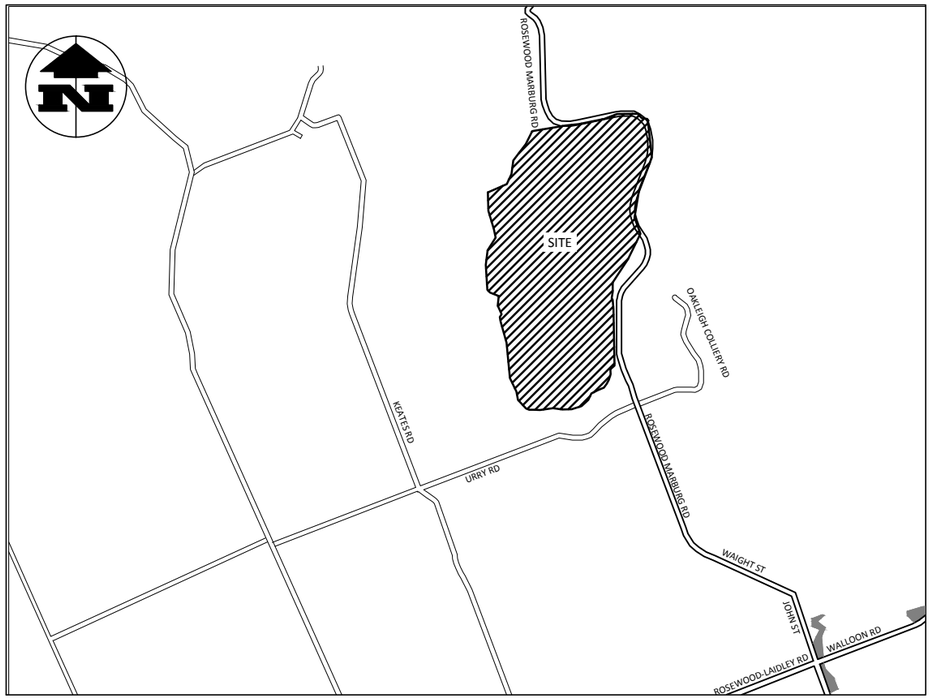
- Significant external catchments flow into the site. These are currently blocked by an earthworks bund on the northern and eastern property boundaries. It is recommended that this bund remain in place until such time that all downstream areas are at least 70% established.
- It is recommended that Contour Banks be constructed, as per the maximum spacings recommended on drawing C020. This will direct runoff to the central overland flow paths provided, and also aid in preventing erosion.
- Filling activities and stabilisation of areas should be staged, from downstream to upstream and typically west to east allowing the downstream areas to establish first.
- Upstream areas should be left 1m low at the stage boundary providing a stormwater catch pond, and also protecting downstream areas which are establishing.
- Rock lined flow channels and stay turfed flow paths should be constructed within the site directing runoff to either the existing dam in the south eastern corner or the existing vegetated areas within the site. Location of these flow paths have been determined based on rehabilitation contours proposed by New Hope Group.
- Rock check dams should be constructed at the intersection of contour banks and the main channel lines.
- The formerly established areas to the west have been reviewed both on site and using aerial photography. Based on what was witnessed on site, areas appear to be sufficiently vegetated, preventing issues with erosion. It is recommended that a more detailed site review be undertaken of the flow paths. Should significant erosion be present methods outlined in Section 6.0 above should be implemented.

APPENDIX A

DRAWINGS

OAKLEIGH WEST
MINE REHABILITATION

DRAWING INDEX	
C000	DRAWING LIST AND LOCALITY PLAN
C020	EROSION & SEDIMENT CONTROL NOTES AND DETAILS
C021	EROSION AND SEDIMENT CONTROL LAYOUT SHEET 1
C022	EROSION AND SEDIMENT CONTROL LAYOUT SHEET 2
C023	INDICATIVE STAGING PLAN SHEET 1
C024	INDICATIVE STAGING PLAN SHEET 2



LOCALITY MAP
BRISBANE UBD MAP REF: 209, GRID Q9
N.T.S

STATUS
PRELIMINARY

REV.	DATE	AMENDMENT / ISSUE	DWN	DES	CHK	APP
A	24.05.13	FOR INFORMATION				

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APPROVED
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CLIENT
NEW HOPE COAL CORPORATION LIMITED

PROJECT
OAKLEIGH WEST MINE REHABILITATION

SUBJECT
DRAWING LIST AND LOCALITY PLAN

PROJECT No.
13119

DRAWING No. C000
REVISION A

A1

EROSION & SEDIMENTATION CONTROL NOTES:

1. TOPSOIL
   - 1.1. MINIMUM SLOPE ACROSS AREAS TO BE 1% TO ENSURE ALL AREAS ARE FREE DRAINING.
   - 1.2. ALL EARTHWORK AFFECTED AREAS ARE TO BE TOPSOILED TO A MINIMUM DEPTH OF 100mm (LIGHTLY COMPACTED) & SEEDED.

2. SEDIMENT FENCES
   - 2.1. FOR DETAILS OF SEDIMENT FENCE REFER DETAIL ASIDE
   - 2.2. SEDIMENT FENCES TO BE REPAIRED AS REQUIRED & EXCESSIVE SEDIMENT DEPOSITS SHOULD BE REMOVED ONCE CAPACITY FALLS BELOW 75%.
   - 2.3. REGULAR WEEKLY CHECKS OF SEDIMENT FENCES IS TO BE MADE ALONG WITH A CHECK AFTER ANY SIGNIFICANT STORM EVENT TO ENSURE INTEGRITY & PERFORMANCE.

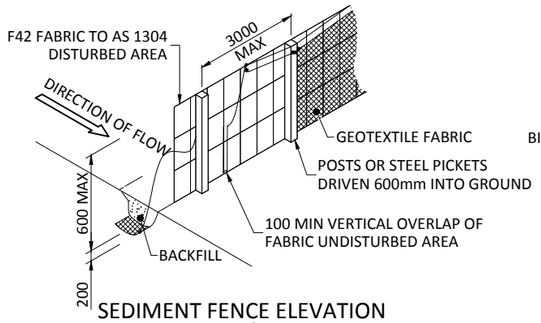
3. DURING CONSTRUCTION SEQUENCE
   - 3.1. FILL TO BE BROUGHT TO FINAL LEVEL AND STABILISED FROM DOWNSTREAM TO UPSTREAM. LEAVE UPSTREAM INCOMPLETE AREAS LOW TO FINISHED SECTIONS, PROVIDING A STORMWATER PUMP OUT LOCATION. REMOVE SILT AND SEDIMENT DEPOSITS FOLLOWING LARGE RAINFALL EVENTS. PUMP STORMWATER TO ESTABLISHING AREAS.
   - 3.2. STOCKPILE SITE TO HAVE A SEDIMENTATION FENCE CONSTRUCTED ON DOWNSTREAM SIDE.
   - 3.3. SEDIMENTATION FENCES TO BE PLACED AS SHOWN.
   - 3.4. REGULARLY INSPECT BANKS & REPAIR ANY SLUMPS, WHEEL TRACK DAMAGE OR LOSS OF FREEBOARD.
   - 3.5. REMOVE SEDIMENT TO AVOID PONDING ON CONTOUR BANKS
   - 3.6. ROAD RESERVE TO BE USED AS HAUL ROAD.
   - 3.7. A CATCH DRAIN BANK IS TO BE PROVIDED ON THE TOP SIDE OF ALL CUTS & DISCHARGE EITHER TO UNDISTURBED GRASS LANDS OR TO THE CROSS ROAD DRAINAGE
   - 3.8. WATER QUALITY SAMPLES MUST BE TAKEN & ANALYSED PRIOR TO THE RELEASE OF ANY WATER FROM THE SEDIMENT POND. WATER QUALITY MUST SATISFY THE FOLLOWING CRITERIA: TSS<50mg/L pH BETWEEN 6.5 & 8.5. IF WATER QUALITY FAILS THE CRITERIA THEN THE USE OF A GYPSUM FLOCCULENT IS TO BE APPLIED AS DIRECTED BY THE SUPERINTENDENT.
   - 3.9. ALL WATER QUALITY DATA INCLUDING DATES OF RAINFALL, TESTING & WATER RELEASE MUST BE MAINTAINED IN AN ON-SITE REGISTER. THIS REGISTER IS TO BE MAINTAINED FOR THE DURATION OF THE APPROVED WORKS & BE AVAILABLE ON SITE FOR INSPECTION BY COUNCIL OFFICERS ON REQUEST.
   - 3.10. GRASS SEEDING IS TO ACHIEVE 70% COVER WITHIN 30 DAYS OF COMPLETION OF EARTHWORKS.

4. FOLLOWING CONSTRUCTION
   - 4.1. SEDIMENTATION FENCES TO BE MAINTAINED UNTIL GRASS IS 70% ESTABLISHED.
   - 4.2. SEDIMENT FENCES TO BE CHECKED & DE-SILTED AFTER EVERY SIGNIFICANT STORM EVENT OR IN THE CASE OF NO SIGNIFICANT STORM EVENT, EVERY 12 WEEKS.
   - 4.3. CONTOUR BANKS AND FLOW PATHS TO BE CHECKED AND MAINTAINED POST STORM EVENT.

EROSION & SEDIMENT CONTROL PROGRAM

1. THE BASIC OBJECTIVES OF THE EROSION AND SEDIMENT CONTROL ARE :
   - 1.1. IDENTIFY CRITICAL AREAS AND PROVIDE SPECIAL ATTENTION TO THOSE AREAS.
   - 1.2. PLAN SITE LAYOUTS SO THAT ACCESS TO ALL REQUIRED DRAINAGE EROSION AND SEDIMENT CONTROL MEASURES IS MAINTAINED.
   - 1.3. LIMIT EXPOSURE TIME BY PROGRAMMING TO MINIMISE THE AREA OF LAND EXPOSED TO POTENTIALLY ADVERSE WEATHER CONDITIONS AT ANY ONE TIME.
   - 1.4. PROVIDE CONTROL MEASURES INCLUDING TEMPORARY AND PERMANENT DRAINAGE, EROSION AND SEDIMENT CONTROLS.
2. THE EROSION AND SEDIMENT CONTROL SHALL COMPLY WITH LOCAL AUTHORITY EROSION AND SEDIMENT CONTROL STANDARDS, THE SOIL EROSION AND SEDIMENTATION CONTROL - ENGINEERING GUIDELINES FOR QUEENSLAND (CURRENT EDITIONS), AND ALL OTHER LOCAL AUTHORITY EROSION AND SEDIMENT CONTROL GUIDELINES.
3. ALL ESC DEVICES ARE TO BE INSPECTED WEEKLY, PRIOR TO EXPECTED AND AFTER RAINFALL. ANY DAMAGE OR EXCESS EROSION/ SEDIMENT IS TO BE REPAIRED AND MANAGED AS REQUIRED TO MAINTAIN CONTROL DEVICES.
4. WATER DISCHARGE
   5.1 CRITERIA: Samples must be taken and analysed prior to the release of water from ponds.
   - TSS<50 mg/L
   - pH BETWEEN 6.5 AND 8.5.

   5.2 TREATMENT:
   - High TSS: Add Gypsum. BCC Guideline suggests 32 to 70kg/400m³ water.
   - Low ph: Add Aglime/Hydrated Lime or Sodium Bicarbonate. Refer QLD SPP 2/02 Guideline, Table 5 for suggested dosage rates.
   - High pH: Add Citric Acid. Testing for both pH & Alkalinity are necessary to determine dosage rates.
6. ALL WATER QUALITY DATA INCLUDING DATES OF RAINFALL, TESTING AND WATER RELEASE MUST BE MAINTAINED IN AN ON-SITE REGISTER. THIS REGISTER IS TO BE MAINTAINED FOR THE DURATION OF THE APPROVED WORKS AND BE AVAILABLE ON SITE FOR INSPECTION BY COUNCIL OFFICERS ON REQUEST.
7. ALL TEMPORARY EROSION AND SEDIMENT CONTROL (ESC) MEASURES TO BE MAINTAINED AND FULLY OPERATIONAL UNTIL SUCH TIME THAT ALL AREAS ARE ESTABLISHED.
8. EARTHWORKS SHALL BE CARRIED OUT IN SUCH A MANNER THAT THE SITE IS MAINTAINED IN A WELL DRAINED CONDITION, AREAS OF LOOSE SOIL ARE MINIMISED AND CONCENTRATIONS OF STORMWATER ARE MINIMISED.
9. CONSTRUCTION ACCESS SHALL BE AT ONLY ONE NOMINATED POINT ON URRY ROAD.
10. FOR DETAILS OF TEMPORARY CONSTRUCTION ENTRY/EXIT SEDIMENT TRAP AREA REFER TO IPWEAQ STANDARD DRAWING DS-040.
11. SUPPLEMENTARY EROSION AND SEDIMENT CONTROL DEVICES MAY BE REQUIRED AT THE DISCRETION OF THE SITE ENGINEER.
12. SEDIMENT CONTROL DEVICES SHALL BE PROVIDED WHERE SHOWN ON THE DRAWINGS. SEDIMENT TRAPS SHALL REMAIN IN PLACE UNTIL AT LEAST 70% SOIL COVERAGE UPSTREAM AND DOWNSTREAM OF THE DEVICE IS ACHIEVED AND/OR AS DIRECTED BY COUNCIL.
13. SEDIMENT FENCES TO BE PLACED AS SHOWN. FOR DETAILS OF SEDIMENT FENCE REFER IPWEAQ STANDARD DRAWING D-0040. THE ENDS OF ALL SEDIMENT FENCES ARE TO RETURN UP THE CONTOUR SO AS TO RETAIN ALL SEDIMENT.
14. SEDIMENT FENCES TO BE REPAIRED AND EXCESSIVE SEDIMENT DEPOSITS SHALL BE REMOVED ONCE THE FENCE REACHES 75% OF ITS CAPACITY.
15. STORMWATER PUMPED OUT FROM UPSTREAM STAGES TO BE DISCHARGED INTO ESTABLISHED AREAS ONCE WATER QUALITY CRITERIA IS ACHIEVED.



SEDIMENT FENCE ELEVATION
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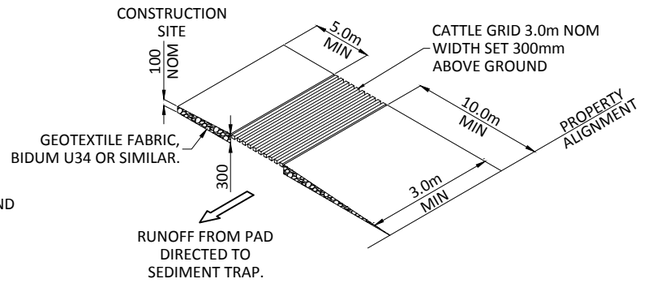
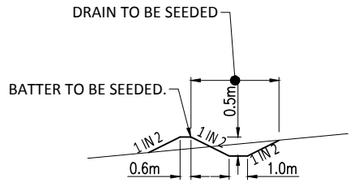


NOTE 1: UNBOUND PAVEMENT MATERIAL (GRAVEL) TO GRADING B, TABLE 9 OF QT SPECIFICATION MRS11.05, EXCLUDE MATERIAL FINER THAN AS SIEVE 2.36mm.

TEMPORARY CONSTRUCTION ENTRY / EXIT SEDIMENT TRAP
NTS



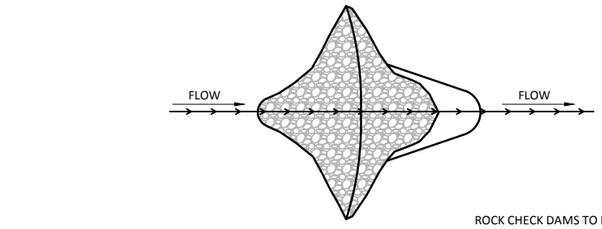
CONTOUR BANK
N.T.S.

NOTE: PROVIDE CONTOUR BANKS ACROSS SLOPES AT SPACING RECOMMENDED BY PLANS. GRADE INVERT OF BUND AT 1% TYP TO STABILISED CHANNEL

CONTOUR BANK SPACING TABLE

CATCHMENT (DISTURBED AREA)	CONTOUR BANK PLAN SPACING
1.0	19m
2.0	19m
3.0	30m
4.0	30m
5.0	40m
6.0	19m
7.0	40m
8.0	22m
9.0	28m
10.0	40m
11.0	32m

NOTE: REFER CONTOUR BANK DETAIL



PLAN
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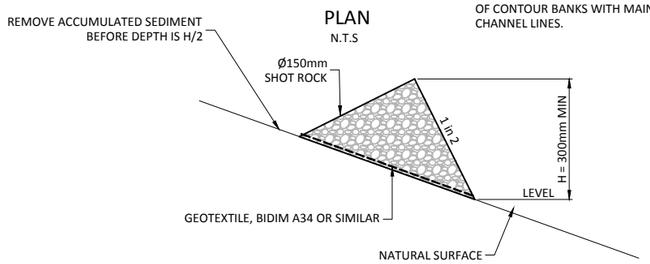
ROCK CHECK DAMS TO BE PROVIDED AT THE INTERSECTION OF CONTOUR BANKS WITH MAIN CHANNEL LINES.

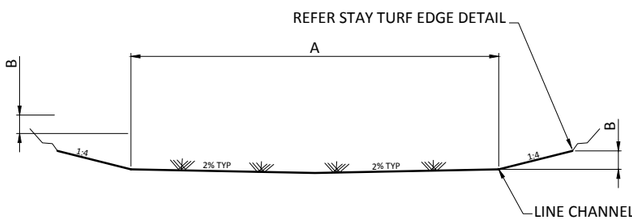


ELEVATION (1) N.T.S

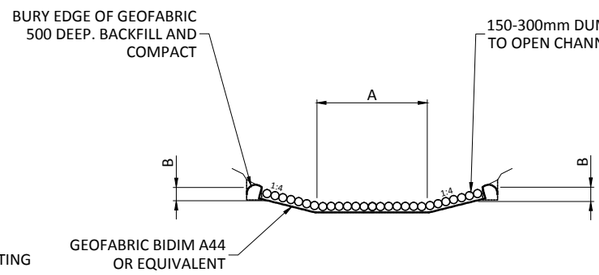
CHECK DAM DETAILS

CHANNEL PROFILE TABLE

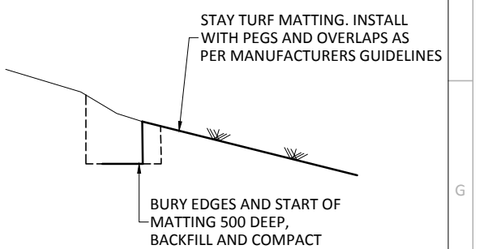
CHANNEL	A	B	COMMENTS
1	4m	0.8m	150-300mm DUMPED ROCK AND GEOFABRIC BIDIM A44 OR EQUIVALENT
2	2m	0.8m	150-300mm DUMPED ROCK AND GEOFABRIC BIDIM A44 OR EQUIVALENT
3	20m	0.8m	STAY TURF, INSTALLED WITH PEGS AS PER MANUFACTURERS GUIDLINES
4	10m	0.8m	STAY TURF, INSTALLED WITH PEGS AS PER MANUFACTURERS GUIDLINES



CHANNEL PROFILE DETAILS 3 AND 4
N.T.S.



CHANNEL PROFILE DETAILS 1 AND 2
N.T.S.



STAY TURF EDGE DETAIL
N.T.S.

STATUS

PRELIMINARY

REV.	DATE	AMENDMENT / ISSUE	DWN	DES	CHK	APP
A	24.05.13	FOR INFORMATION				

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CONSULT AUSTRALIA Member Firm

CLIENT: NEW HOPE COAL CORPORATION LIMITED

PROJECT: OAKLEIGH WEST MINE REHABILITATION

SUBJECT: EROSION & SEDIMENT CONTROL NOTES AND DETAILS

PROJECT No. 13119

DRAWING No. C020

REVISION A

A1

PLAN
SCALE A

LEGEND

EXISTING	PROPOSED	
		PROPERTY BOUNDARY
		FLOW PATHS
TOP OF BATTER / TOE OF BATTER	TOP OF BATTER / TOE OF BATTER	BATTER
52	52	CONTOURS
		TEMPORARY CONSTRUCTION ENTRY/EXIT SEDIMENT TRAP
		EXTENT OF DISTURBANCE
		CATCHMENT BOUNDARY
		CHANNEL PROFILE 1
		CHANNEL PROFILE 2
		CHANNEL PROFILE 3
		CHANNEL PROFILE 4
		EXISTING BUND
	9.0	CATCHMENT NO.
		FILL
		CONTOUR BANKS

NOTE: PROVIDE CONTOUR BANKS AS PER TABLE ON DRG C020, AND ROCK CHECK DAMS AT INTERSECTION OF CONTOUR BANKS WITH MAIN CHANNEL LINES.

PROJECT NORTH

DIMENSIONS IN METRES EXCEPT WHERE SHOWN OTHERWISE. CULVERT AND PIPE SIZES IN MILLIMETRES — A1 UNREDUCED, A3 REDUCED

SCALES — UNREDUCED / REDUCED

A 0 20 40 60 80 100m 1 : 2000 / 1 : 4000

STATUS

PRELIMINARY

REV.	DATE	AMENDMENT / ISSUE	DWN	DES	CHK	APP
A	24.05.13	FOR INFORMATION				

ASSOCIATED CONSULTANTS

APPROVED . . . . . RPEQ
DATE

CHECKED
DATE

BORNHORST + WARD
CONSULTING ENGINEERS
CIVIL AND STRUCTURAL
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Brisbane Australia
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mail@bornhorstward.com.au
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CLIENT: NEW HOPE COAL CORPORATION LIMITED

PROJECT: OAKLEIGH WEST MINE REHABILITATION

SUBJECT: EROSION AND SEDIMENT CONTROL LAYOUT SHEET 1

PROJECT No. 13119

DRAWING No. C021 REVISION A

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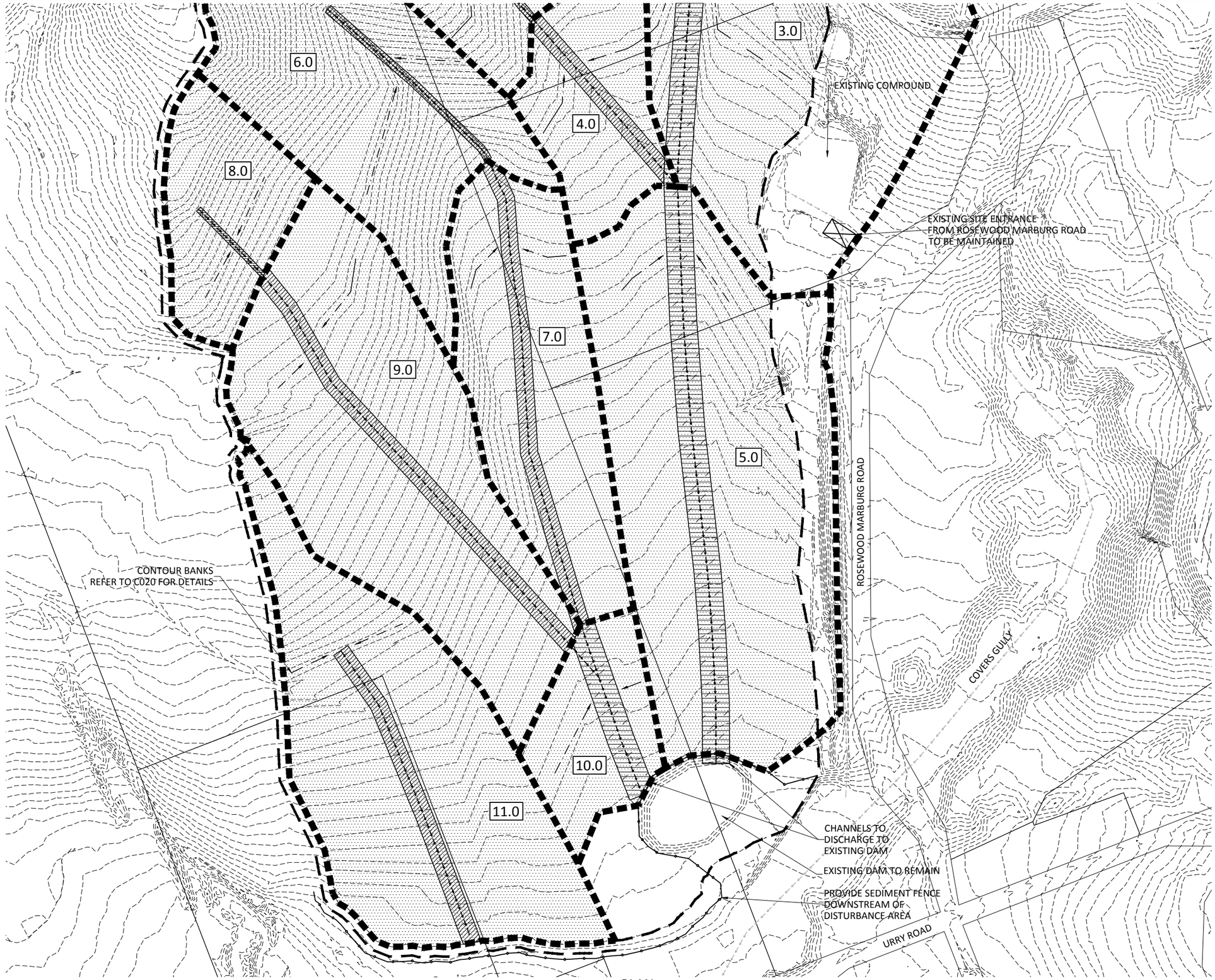

PLAN
SCALE A

LEGEND

EXISTING	PROPOSED	
		PROPERTY BOUNDARY
		FLOW PATHS
TOP OF BATTER / TOE OF BATTER	TOP OF BATTER / TOE OF BATTER	BATTER
52	52	CONTOURS
		TEMPORARY CONSTRUCTION ENTRY/EXIT SEDIMENT TRAP
		EXTENT OF DISTURBANCE
		CATCHMENT BOUNDARY
		SEDIMENT FENCE
		DIVERSION DRAIN
		CHANNEL PROFILE 1
		CHANNEL PROFILE 2
		CHANNEL PROFILE 3
		CHANNEL PROFILE 4
		EXISTING BUND
	9.0	CATCHMENT NO.
		FILL
		CONTOUR BANKS

NOTE: PROVIDE CONTOUR BANKS AS PER TABLE ON DRG C020, AND ROCK CHECK DAMS AT INTERSECTION OF CONTOUR BANKS WITH MAIN CHANNEL LINES.

CATCHMENT TABLE

CATCHMENT	AREA (Ha)
1.0	26.99
2.0	8.94
3.0	11.28
4.0	3.07
5.0	12.02
6.0	9.35
7.0	5.40
8.0	2.72
9.0	9.55
10.0	2.29
11.0	8.82

PROJECT NORTH

DIMENSIONS IN METRES EXCEPT WHERE SHOWN OTHERWISE. CULVERT AND PIPE SIZES IN MILLIMETRES — A1 UNREDUCED, A3 REDUCED

SCALES — UNREDUCED / REDUCED

A 0 20 40 60 80 100m — 1 : 2000 / 1 : 4000

STATUS

PRELIMINARY

REV.	DATE	AMENDMENT / ISSUE	DWN	DES	CHK	APP
A	24.05.13	FOR INFORMATION				

ASSOCIATED CONSULTANTS

APPROVED
RPEQ
DATE

CHECKED
DATE

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CLIENT: NEW HOPE COAL CORPORATION LIMITED

PROJECT: OAKLEIGH WEST MINE REHABILITATION

SUBJECT: EROSION AND SEDIMENT CONTROL LAYOUT SHEET 2

PROJECT No. 13119

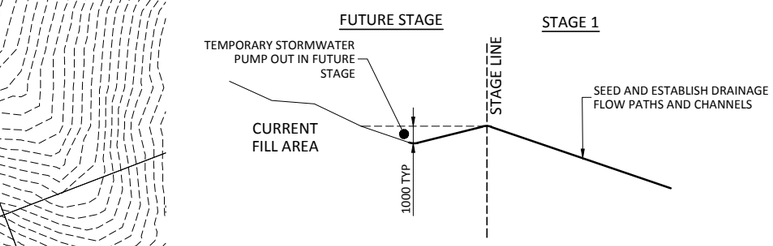
DRAWING No. C022 — REVISION A

A1

PLAN
SCALE A

LEGEND

EXISTING	PROPOSED	
		PROPERTY BOUNDARY
52	52	CONTOURS
		EXISTING TEMPORARY FLOW PATH
		STAGE BOUNDARY
		CHANNEL PROFILE 1
		CHANNEL PROFILE 2
		CHANNEL PROFILE 3
		CHANNEL PROFILE 4
		EXISTING BUND
	13	STAGE NUMBER



NOTE: LEAVE UPSTREAM STAGE 1m LOW AT STAGE LINE UNTIL DOWNSTREAM AREAS ARE 70% ESTABLISHED AND ALL DRAINAGE FLOW PATHS ARE IN PLACE

TYPICAL STAGING CROSS SECTION
N.T.S.

PROJECT NORTH

DIMENSIONS IN METRES EXCEPT WHERE SHOWN OTHERWISE. CULVERT AND PIPE SIZES IN MILLIMETRES — A1 UNREDUCED, A3 REDUCED

SCALES — UNREDUCED / REDUCED

A: 0 20 40 60 80 100m — 1 : 2000 / 1 : 4000

STATUS

PRELIMINARY

REV.	DATE	AMENDMENT / ISSUE	DWN	DES	CHK	APP
A	24.05.13	FOR INFORMATION				

ASSOCIATED CONSULTANTS

APPROVED . . . . . RPEQ . . . . . DATE

CHECKED DATE

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CLIENT: NEW HOPE COAL CORPORATION LIMITED

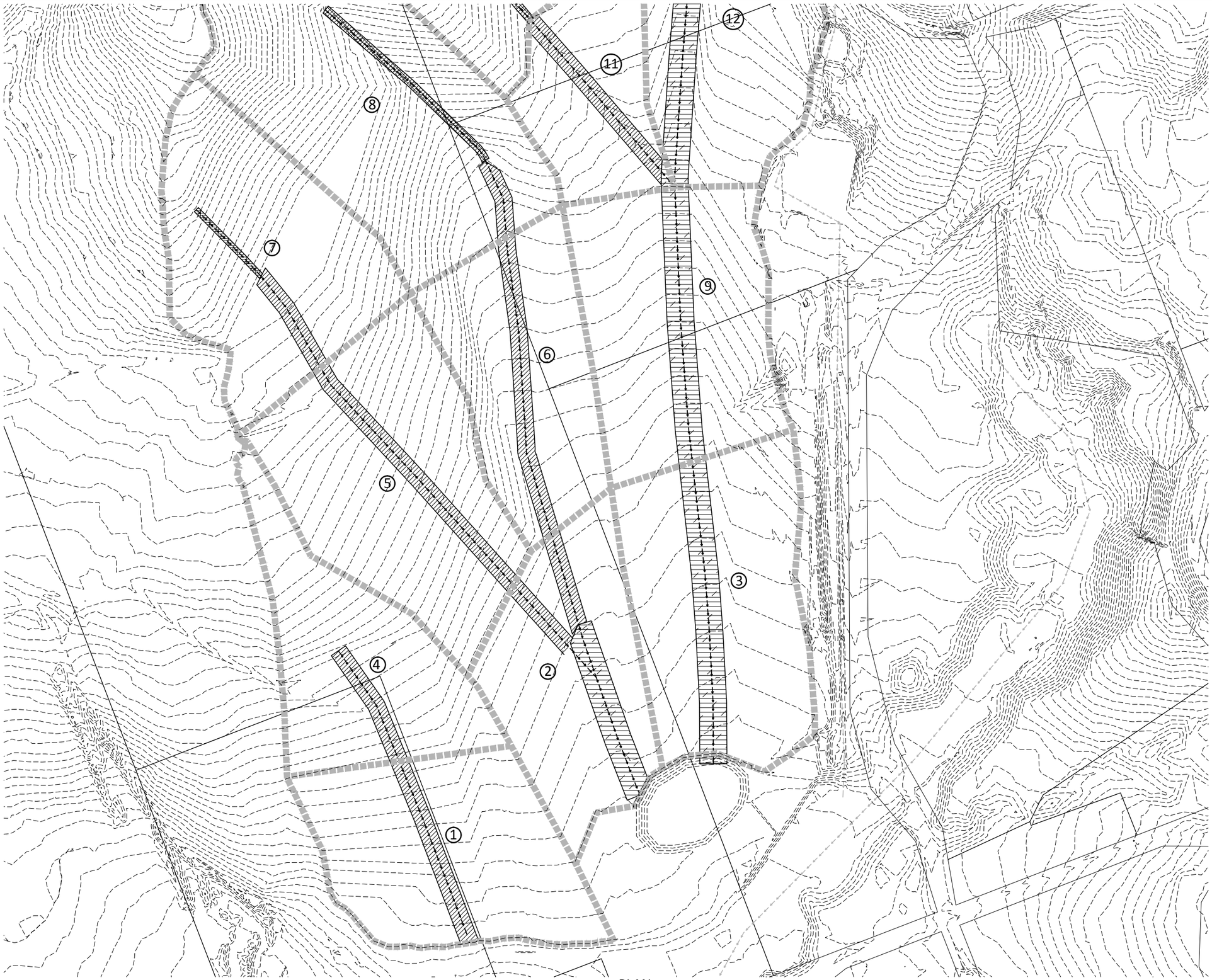
PROJECT: OAKLEIGH WEST MINE REHABILITATION

SUBJECT: INDICATIVE STAGING PLAN SHEET 1

PROJECT No. 13119

DRAWING No. C023 REVISION A

0 10 20 30 40 50 100 150 A1



LEGEND

EXISTING	PROPOSED	
		PROPERTY BOUNDARY
52	52	CONTOURS
		EXISTING TEMPORARY FLOW PATH
		STAGE BOUNDARY
		DIVERSION DRAIN
		CHANNEL PROFILE 1
		CHANNEL PROFILE 2
		CHANNEL PROFILE 3
		CHANNEL PROFILE 4
		EXISTING BUND
	13	STAGE NUMBER

NOTE: REFER TYPICAL STAGING CROSS SECTIONS DRG C023

PLAN
SCALE A

PROJECT NORTH

DIMENSIONS IN METRES EXCEPT WHERE SHOWN OTHERWISE. CULVERT AND PIPE SIZES IN MILLIMETRES

A1 UNREDUCED
A3 REDUCED

SCALES — UNREDUCED / REDUCED

A 0 20 40 60 80 100m — 1 : 2000 / 1 : 4000

STATUS

PRELIMINARY

REV.	DATE	AMENDMENT / ISSUE	DWN	DES	CHK	APP
A	24.05.13	FOR INFORMATION				

ASSOCIATED CONSULTANTS

APPROVED . . . . . RPEQ
DATE

CHECKED
DATE

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CONSULT AUSTRALIA Member Firm

CLIENT
NEW HOPE COAL CORPORATION LIMITED

PROJECT
OAKLEIGH WEST MINE REHABILITATION

SUBJECT
INDICATIVE STAGING PLAN SHEET 2

PROJECT No. 13119

DRAWING No. C024 — REVISION A

0 10 20 30 40 50 100 150 A1

APPENDIX B

HYDRAULIC CALCULATIONS

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CIVIL AND STRUCTURAL

INITIAL PEAK FLOW CALCULATIONS FOR RURAL CATCHMENTS

Based on QUDM 4.00 'Catchment Hydrology'

Written by BB 14/08/09

Job Number: **13119**
Job Name: **Oakleigh West Mine Rehabilitation**
Portion of Catchment 1
Designed: KR
Checked:

IFD : Ipswich

TOTAL RUNOFF COEFF.			
No.	Area (Ha)	C10	Total C10
1	7.08	0.70	
2			
3			
4			
5			
6			
7			
8			
9			
10			
	7.08		**0.70**

EXISTING TIME OF CONCENTRATION		
Bransby-Williams Equation	Channel Slope (%)	11.5
	Flow Length (km)	0.394
	Area (Ha)	7.08
	Travel Time (min)	11.53
Modified Friends Equation	Channel Slope (%)	11.5
	Flow Length (km)	0.394
	Area (Ha)	7.08
	Left Bank Slope (1 in __)	4
	Right Bank Slope (1 in __)	4
	Base width (m)	5
	Assumed Flood Depth (m)	0.5
	Stream Slope (1=uniform, 0=variable)	0
	Mannings 'n'	0.05
	Wetted Perimeter (m)	9.12
	Channel area (m2)	3.50
	Travel Time	6.15
	Total Time (Tc)	**8.8**

Please note:
User Data to be placed in the Green Cells only

PEAK RUNOFF CALCULATIONS

ARI Storm (yr)	Rainfall Intensity (mm/hr)	Coeficient of Runoff	Peak Runoff Rates (m^3/s)
1	95	0.56	**1.05**
2	123	0.60	**1.44**
5	158	0.67	**2.06**
10	179	0.70	**2.47**
20	208	0.74	**3.01**
50	247	0.81	**3.91**
100	278	0.84	**4.60**

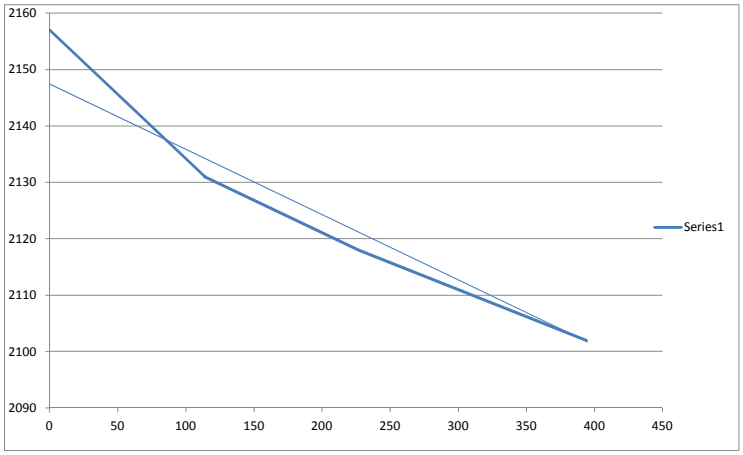
PEAK FLOWS FOR FREQUENT EVENTS

ARI Storm (yr)	Percentage of Q1 (%)	Peak Runoff Rates (m^3/s)
1mth	25%	**0.26**
2mth	40%	**0.42**
3mth	50%	**0.52**
4mth	60%	**0.63**
6mth	75%	**0.79**
9mth	90%	**0.94**
12mth	100%	**1.05**

Catchment Divide	
Length	Slope
0	2157
114	2131
227	2118
394	2102

Equal Area Slope	
Start RL	2147
End RL	2101
Slope %	11.68

Velocity Calculation	
Distance (m)	394
Time (minutes)	8.8
Velocity (m/s)	0.74



BORNHORST + WARD
CONSULTING ENGINEERS
CIVIL AND STRUCTURAL

INITIAL PEAK FLOW CALCULATIONS FOR RURAL CATCHMENTS

Based on QUDM 4.00 'Catchment Hydrology'

Written by BB 14/08/09

Job Number: **13119**
Job Name: **Oakleigh West Mine Rehabilitation**
Catchment 2
Designed: KR
Checked:

IFD : Ipswich

TOTAL RUNOFF COEFF.

No.	Area (Ha)	C10	Total C10
1	8.94	0.70	
2			
3			
4			
5			
6			
7			
8			
9			
10			
	8.94		**0.70**

EXISTING TIME OF CONCENTRATION

Bransby-Williams Equation	Channel Slope (%)	10.3
	Flow Length (km)	0.38
	Area (Ha)	8.94
	Travel Time (min)	11.10
Modified Friends Equation	Channel Slope (%)	10.3
	Flow Length (km)	0.38
	Area (Ha)	8.94
	Left Bank Slope (1 in __)	4
	Right Bank Slope (1 in __)	4
	Base width (m)	5
	Assumed Flood Depth (m)	0.5
	Stream Slope (1=uniform, 0=variable)	0
	Mannings 'n'	0.05
	Wetted Perimeter (m)	9.12
	Channel area (m2)	3.50
	Travel Time	6.05
	Total Time (Tc)	**8.6**

Please note:
User Data to be placed in the Green Cells only

PEAK RUNOFF CALCULATIONS

ARI Storm (yr)	Rainfall Intensity (mm/hr)	Coeficient of Runoff	Peak Runoff Rates (m^3/s)
1	95	0.56	**1.32**
2	123	0.60	**1.82**
5	158	0.67	**2.60**
10	179	0.70	**3.11**
20	208	0.74	**3.80**
50	247	0.81	**4.94**
100	278	0.84	**5.80**

PEAK FLOWS FOR FREQUENT EVENTS

ARI Storm (yr)	Percentage of Q1 (%)	Peak Runoff Rates (m^3/s)
1mth	25%	**0.33**
2mth	40%	**0.53**
3mth	50%	**0.66**
4mth	60%	**0.79**
6mth	75%	**0.99**
9mth	90%	**1.19**
12mth	100%	**1.32**

Catchment Divide

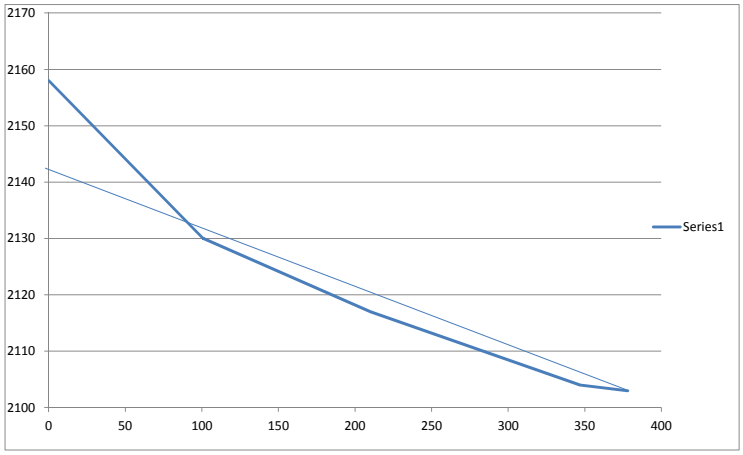
Length	Slope
0	2158
101	2130
210	2117
347	2104
378	2103

Equal Area Slope

Start RL	2142
End RL	2103
Slope %	10.32

Velocity Calculation

Distance (m)	380
Time (minutes)	8.6
Velocity (m/s)	0.74



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CIVIL AND STRUCTURAL

INITIAL PEAK FLOW CALCULATIONS FOR RURAL CATCHMENTS

Based on QUDM 4.00 'Catchment Hydrology'

Written by BB 14/08/09

Job Number: **13119**
Job Name: **Oakleigh West Mine Rehabilitation**
Catchment 3
Designed: KR
Checked:

IFD : Ipswich

TOTAL RUNOFF COEFF.

No.	Area (Ha)	C10	Total C10
1	38.27	0.70	
2			
3			
4			
5			
6			
7			
8			
9			
10			
	38.27		**0.70**

EXISTING TIME OF CONCENTRATION

Bransby-Williams Equation	Channel Slope (%)	5
	Flow Length (km)	0.753
	Area (Ha)	38.27
	Travel Time (min)	21.99
Modified Friends Equation	Channel Slope (%)	5
	Flow Length (km)	0.753
	Area (Ha)	38.27
	Left Bank Slope (1 in __)	4
	Right Bank Slope (1 in __)	4
	Base width (m)	10
	Assumed Flood Depth (m)	0.5
	Stream Slope (1=uniform, 0=variable)	0
	Mannings 'n'	0.05
	Wetted Perimeter (m)	14.12
	Channel area (m2)	6.00
	Travel Time	13.62
	Total Time (Tc)	**17.8**

Please note:
User Data to be placed in the Green Cells only

PEAK RUNOFF CALCULATIONS

ARI Storm (yr)	Rainfall Intensity (mm/hr)	Coeficient of Runoff	Peak Runoff Rates (m^3/s)
1	68	0.56	**4.07**
2	89	0.60	**5.61**
5	115	0.67	**8.13**
10	131	0.70	**9.77**
20	153	0.74	**11.96**
50	183	0.81	**15.64**
100	206	0.84	**18.42**

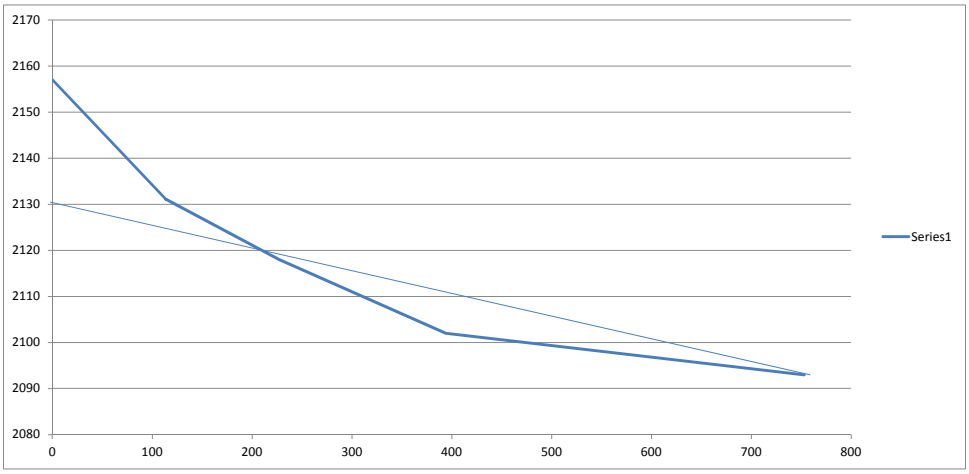
PEAK FLOWS FOR FREQUENT EVENTS

ARI Storm (yr)	Percentage of Q1 (%)	Peak Runoff Rates (m^3/s)
1mth	25%	**1.02**
2mth	40%	**1.63**
3mth	50%	**2.04**
4mth	60%	**2.44**
6mth	75%	**3.05**
9mth	90%	**3.66**
12mth	100%	**4.07**

Catchment Divide	
Length	Slope
0	2157
114	2131
227	2118
394	2102
753	2093

Equal Area Slope	
Start RL	2130
End RL	2093
Slope %	4.91

Velocity Calculation	
Distance (m)	753
Time (minutes)	17.8
Velocity (m/s)	0.70



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CONSULTING ENGINEERS
CIVIL AND STRUCTURAL

INITIAL PEAK FLOW CALCULATIONS FOR RURAL CATCHMENTS

Based on QUDM 4.00 'Catchment Hydrology'

Written by BB 14/08/09

Job Number: **13119**
Job Name: **Oakleigh West Mine Rehabilitation**
Catchment 4
Designed: KR
Checked:

IFD : Ipswich

TOTAL RUNOFF COEFF.

No.	Area (Ha)	C10	Total C10
1	12.01	0.70	
2			
3			
4			
5			
6			
7			
8			
9			
10			
	12.01		**0.70**

EXISTING TIME OF CONCENTRATION

Bransby-Williams Equation	Channel Slope (%)	6.5
	Flow Length (km)	0.607
	Area (Ha)	12.01
	Travel Time (min)	18.88
Modified Friends Equation	Channel Slope (%)	6.5
	Flow Length (km)	0.607
	Area (Ha)	12.01
	Left Bank Slope (1 in __)	4
	Right Bank Slope (1 in __)	4
	Base width (m)	10
	Assumed Flood Depth (m)	0.5
	Stream Slope (1=uniform, 0=variable)	0
	Mannings 'n'	0.05
	Wetted Perimeter (m)	14.12
	Channel area (m2)	6.00
	Travel Time	11.10
	Total Time (Tc)	**15.0**

Please note:
User Data to be placed in the Green Cells only

PEAK RUNOFF CALCULATIONS

ARI Storm (yr)	Rainfall Intensity (mm/hr)	Coeficient of Runoff	Peak Runoff Rates (m^3/s)
1	75	0.56	**1.40**
2	97	0.60	**1.93**
5	125	0.67	**2.78**
10	143	0.70	**3.34**
20	167	0.74	**4.08**
50	199	0.81	**5.33**
100	224	0.84	**6.28**

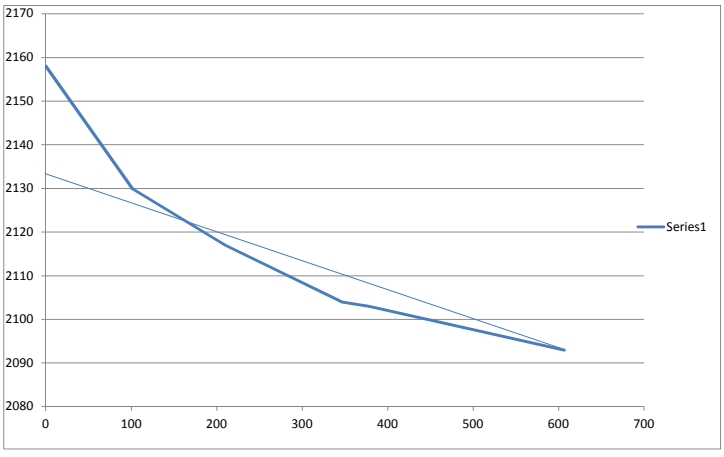
PEAK FLOWS FOR FREQUENT EVENTS

ARI Storm (yr)	Percentage of Q1 (%)	Peak Runoff Rates (m^3/s)
1mth	25%	**0.35**
2mth	40%	**0.56**
3mth	50%	**0.70**
4mth	60%	**0.84**
6mth	75%	**1.05**
9mth	90%	**1.26**
12mth	100%	**1.40**

Catchment Divide	
Length	Slope
0	2158
101	2130
210	2117
347	2104
378	2103
607	2093

Equal Area Slope	
Start RL	2133
End RL	2093
Slope %	6.59

Velocity Calculation	
Distance (m)	607
Time (minutes)	15.0
Velocity (m/s)	0.67



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CIVIL AND STRUCTURAL

INITIAL PEAK FLOW CALCULATIONS FOR RURAL CATCHMENTS

Based on QUDM 4.00 'Catchment Hydrology'

Written by BB 14/08/09

Job Number: **13119**
Job Name: **Oakleigh West Mine Rehabilitation**
Catchment 5
Designed: KR
Checked:

IFD : Ipswich

TOTAL RUNOFF COEFF.

No.	Area (Ha)	C10	Total C10
1	62.31	0.70	
2			
3			
4			
5			
6			
7			
8			
9			
10			
	62.31		**0.70**

EXISTING TIME OF CONCENTRATION

Bransby-Williams Equation	Channel Slope (%)	3.5
	Flow Length (km)	1.34
	Area (Ha)	62.31
	Travel Time (min)	40.02
Modified Friends Equation	Channel Slope (%)	3.5
	Flow Length (km)	1.34
	Area (Ha)	62.31
	Left Bank Slope (1 in __)	4
	Right Bank Slope (1 in __)	4
	Base width (m)	10
	Assumed Flood Depth (m)	0.5
	Stream Slope (1=uniform, 0=variable)	0
	Mannings 'n'	0.05
	Wetted Perimeter (m)	14.12
	Channel area (m2)	6.00
	Travel Time	26.62
	Total Time (Tc)	**33.3**

Please note:
User Data to be placed in the Green Cells only

PEAK RUNOFF CALCULATIONS

ARI Storm (yr)	Rainfall Intensity (mm/hr)	Coeficient of Runoff	Peak Runoff Rates (m^3/s)
1	49	0.56	**4.73**
2	64	0.60	**6.55**
5	83	0.67	**9.57**
10	95	0.70	**11.56**
20	112	0.74	**14.22**
50	134	0.81	**18.70**
100	152	0.84	**22.10**

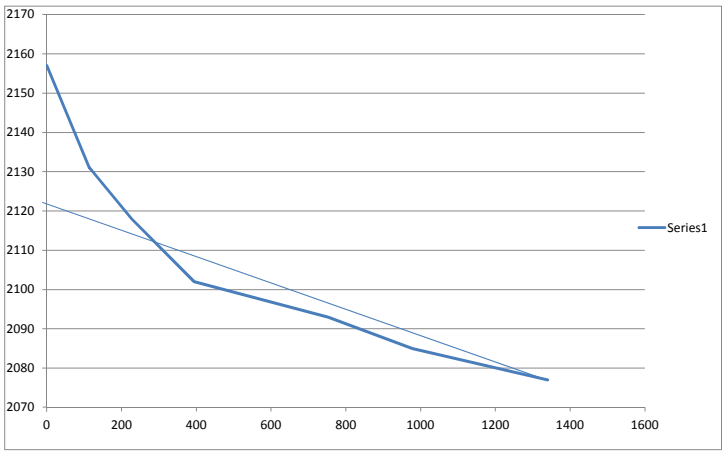
PEAK FLOWS FOR FREQUENT EVENTS

ARI Storm (yr)	Percentage of Q1 (%)	Peak Runoff Rates (m^3/s)
1mth	25%	**1.18**
2mth	40%	**1.89**
3mth	50%	**2.37**
4mth	60%	**2.84**
6mth	75%	**3.55**
9mth	90%	**4.26**
12mth	100%	**4.73**

Catchment Divide	
Length	Slope
0	2157
114	2131
227	2118
394	2102
753	2093
978	2085
1340	2077

Equal Area Slope	
Start RL	2122
End RL	2077
Slope %	3.36

Velocity Calculation	
Distance (m)	1340
Time (minutes)	33.3
Velocity (m/s)	0.67



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CIVIL AND STRUCTURAL

INITIAL PEAK FLOW CALCULATIONS FOR RURAL CATCHMENTS

Based on QUDM 4.00 'Catchment Hydrology'

Written by BB 14/08/09

Job Number: **13119**
Job Name: **Oakleigh West Mine Rehabilitation**
Catchment 6
Designed: KR
Checked:

IFD : Ipswich

TOTAL RUNOFF COEFF.

No.	Area (Ha)	C10	Total C10
1	9.35	0.70	
2			
3			
4			
5			
6			
7			
8			
9			
10			
	9.35		**0.70**

EXISTING TIME OF CONCENTRATION

Bransby-Williams Equation	Channel Slope (%)	9.2
	Flow Length (km)	0.326
	Area (Ha)	9.35
	Travel Time (min)	9.70
Modified Friends Equation	Channel Slope (%)	9.2
	Flow Length (km)	0.326
	Area (Ha)	9.35
	Left Bank Slope (1 in __)	4
	Right Bank Slope (1 in __)	4
	Base width (m)	5
	Assumed Flood Depth (m)	0.5
	Stream Slope (1=uniform, 0=variable)	0
	Mannings 'n'	0.05
	Wetted Perimeter (m)	9.12
	Channel area (m2)	3.50
	Travel Time	5.41
	Total Time (Tc)	**7.6**

Please note:
User Data to be placed in the Green Cells only

PEAK RUNOFF CALCULATIONS

ARI Storm (yr)	Rainfall Intensity (mm/hr)	Coeficient of Runoff	Peak Runoff Rates (m^3/s)
1	100	0.56	**1.46**
2	129	0.60	**2.00**
5	166	0.67	**2.86**
10	188	0.70	**3.42**
20	218	0.74	**4.17**
50	259	0.81	**5.42**
100	292	0.84	**6.36**

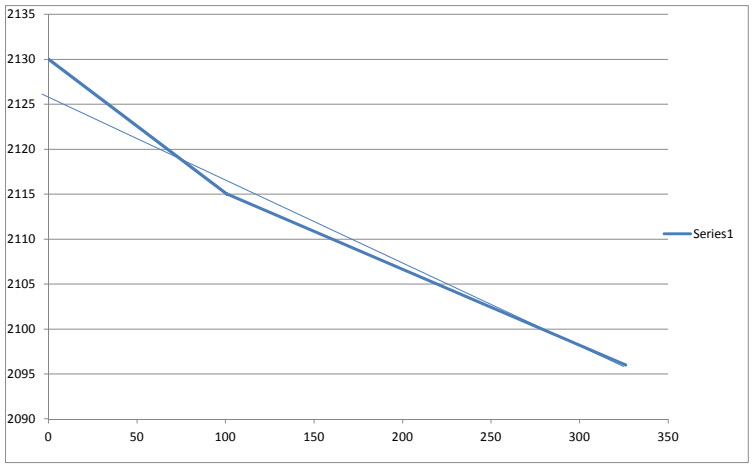
PEAK FLOWS FOR FREQUENT EVENTS

ARI Storm (yr)	Percentage of Q1 (%)	Peak Runoff Rates (m^3/s)
1mth	25%	**0.36**
2mth	40%	**0.58**
3mth	50%	**0.73**
4mth	60%	**0.87**
6mth	75%	**1.09**
9mth	90%	**1.31**
12mth	100%	**1.46**

Catchment Divide	
Length	Slope
0	2130
101	2115
326	2096

Equal Area Slope	
Start RL	2126
End RL	2096
Slope %	9.20

Velocity Calculation	
Distance (m)	326
Time (minutes)	7.6
Velocity (m/s)	0.72



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CIVIL AND STRUCTURAL

INITIAL PEAK FLOW CALCULATIONS FOR RURAL CATCHMENTS

Based on QUDM 4.00 'Catchment Hydrology'

Written by BB 14/08/09

Job Number: **13119**
Job Name: **Oakleigh West Mine Rehabilitation**
Catchment 7
Designed: KR
Checked:

IFD : Ipswich

TOTAL RUNOFF COEFF.			
No.	Area (Ha)	C10	Total C10
1	14.75	0.70	
2			
3			
4			
5			
6			
7			
8			
9			
10			
	14.75		**0.70**

EXISTING TIME OF CONCENTRATION		
Bransby-Williams Equation	Channel Slope (%)	3.7
	Flow Length (km)	0.817
	Area (Ha)	14.75
	Travel Time (min)	27.87
Modified Friends Equation	Channel Slope (%)	3.7
	Flow Length (km)	0.817
	Area (Ha)	14.75
	Left Bank Slope (1 in __)	4
	Right Bank Slope (1 in __)	4
	Base width (m)	10
	Assumed Flood Depth (m)	0.5
	Stream Slope (1=uniform, 0=variable)	0
	Mannings 'n'	0.05
	Wetted Perimeter (m)	14.12
	Channel area (m2)	6.00
	Travel Time	18.33
	Total Time (Tc)	**23.1**

Please note:
User Data to be placed in the Green Cells only

RUNOFF CALCULATIONS

ARI Storm (yr)	Rainfall Intensity (mm/hr)	Coeficient of Runoff	Peak Runoff Rates (m^3/s)
1	59	0.56	**1.35**
2	77	0.60	**1.87**
5	100	0.67	**2.72**
10	114	0.70	**3.27**
20	133	0.74	**4.01**
50	160	0.81	**5.26**
100	180	0.84	**6.21**

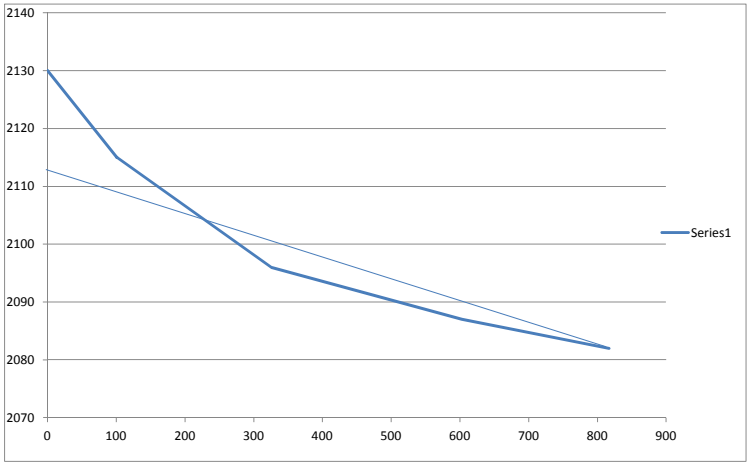
PEAK FLOWS FOR FREQUENT EVENTS

ARI Storm (yr)	Percentage of Q1 (%)	Peak Runoff Rates (m^3/s)
1mth	25%	**0.34**
2mth	40%	**0.54**
3mth	50%	**0.68**
4mth	60%	**0.81**
6mth	75%	**1.01**
9mth	90%	**1.22**
12mth	100%	**1.35**

Catchment Divide	
Length	Slope
0	2130
101	2115
326	2096
603	2087
817	2082

Equal Area Slope	
Start RL	2113
End RL	2082
Slope %	3.79

Velocity Calculation	
Distance (m)	817
Time (minutes)	23.1
Velocity (m/s)	0.59



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CIVIL AND STRUCTURAL

INITIAL PEAK FLOW CALCULATIONS FOR RURAL CATCHMENTS

Based on QUDM 4.00 'Catchment Hydrology'

Written by BB 14/08/09

Job Number: **13119**
Job Name: **Oakleigh West Mine Rehabilitation**
Catchment 8
Designed: KR
Checked:

IFD : Ipswich

TOTAL RUNOFF COEFF.

No.	Area (Ha)	C10	Total C10
1	2.72	0.70	
2			
3			
4			
5			
6			
7			
8			
9			
10			
	2.72		**0.70**

EXISTING TIME OF CONCENTRATION

Bransby-Williams Equation	Channel Slope (%)	12
	Flow Length (km)	0.113
	Area (Ha)	2.72
	Travel Time (min)	3.61
Modified Friends Equation	Channel Slope (%)	12
	Flow Length (km)	0.113
	Area (Ha)	2.72
	Left Bank Slope (1 in __)	4
	Right Bank Slope (1 in __)	4
	Base width (m)	10
	Assumed Flood Depth (m)	0.5
	Stream Slope (1=uniform, 0=variable)	0
	Mannings 'n'	0.05
	Wetted Perimeter (m)	14.12
	Channel area (m2)	6.00
	Travel Time	1.88
	Total Time (Tc)	**5.0**

std inlet.

Please note:
User Data to be placed in the Green Cells only

PEAK RUNOFF CALCULATIONS

ARI Storm (yr)	Rainfall Intensity (mm/hr)	Coeficient of Runoff	Peak Runoff Rates (m^3/s)
1	113	0.56	**0.48**
2	146	0.60	**0.66**
5	187	0.67	**0.94**
10	211	0.70	**1.12**
20	245	0.74	**1.36**
50	290	0.81	**1.77**
100	326	0.84	**2.07**

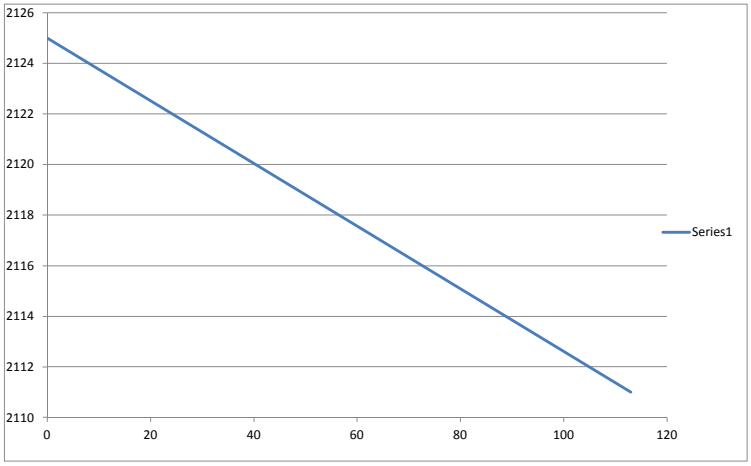
PEAK FLOWS FOR FREQUENT EVENTS

ARI Storm (yr)	Percentage of Q1 (%)	Peak Runoff Rates (m^3/s)
1mth	25%	**0.12**
2mth	40%	**0.19**
3mth	50%	**0.24**
4mth	60%	**0.29**
6mth	75%	**0.36**
9mth	90%	**0.43**
12mth	100%	**0.48**

Catchment Divide	
Length	Slope
0	2125
113	2111

Equal Area Slope	
Start RL	2125
End RL	2111
Slope %	12.39

Velocity Calculation	
Distance (m)	113
Time (minutes)	5.0
Velocity (m/s)	0.38



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CIVIL AND STRUCTURAL

INITIAL PEAK FLOW CALCULATIONS FOR RURAL CATCHMENTS

Based on QUDM 4.00 'Catchment Hydrology'

Written by BB 14/08/09

Job Number: **13119**
Job Name: **Oakleigh West Mine Rehabilitation**
Catchment 9
Designed: KR
Checked:

IFD : Ipswich

TOTAL RUNOFF COEFF.

No.	Area (Ha)	C10	Total C10
1	12.27	0.70	
2			
3			
4			
5			
6			
7			
8			
9			
10			
	12.27		**0.70**

EXISTING TIME OF CONCENTRATION

Bransby-Williams Equation	Channel Slope (%)	6
	Flow Length (km)	0.618
	Area (Ha)	12.27
	Travel Time (min)	19.49
Modified Friends Equation	Channel Slope (%)	6
	Flow Length (km)	0.618
	Area (Ha)	12.27
	Left Bank Slope (1 in __)	4
	Right Bank Slope (1 in __)	4
	Base width (m)	10
	Assumed Flood Depth (m)	0.5
	Stream Slope (1=uniform, 0=variable)	0
	Mannings 'n'	0.05
	Wetted Perimeter (m)	14.12
	Channel area (m2)	6.00
	Travel Time	11.64
	Total Time (Tc)	**15.6**

Please note:
User Data to be placed in the Green Cells only

PEAK RUNOFF CALCULATIONS

ARI Storm (yr)	Rainfall Intensity (mm/hr)	Coeficient of Runoff	Peak Runoff Rates (m^3/s)
1	73	0.56	**1.38**
2	94	0.60	**1.91**
5	122	0.67	**2.76**
10	139	0.70	**3.31**
20	162	0.74	**4.05**
50	193	0.81	**5.29**
100	218	0.84	**6.23**

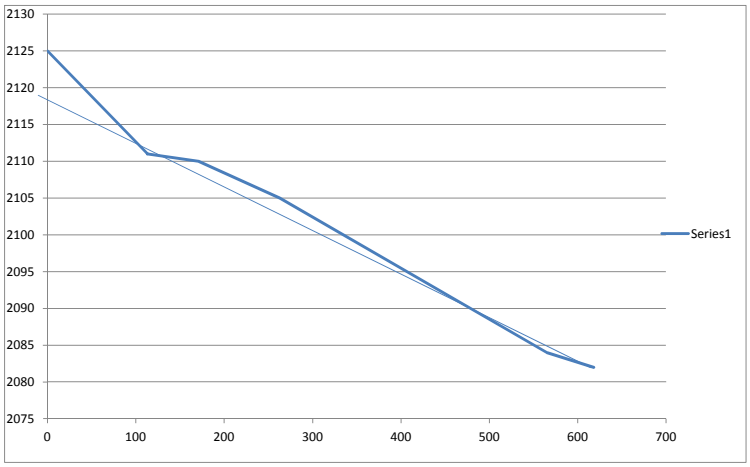
PEAK FLOWS FOR FREQUENT EVENTS

ARI Storm (yr)	Percentage of Q1 (%)	Peak Runoff Rates (m^3/s)
1mth	25%	**0.35**
2mth	40%	**0.55**
3mth	50%	**0.69**
4mth	60%	**0.83**
6mth	75%	**1.04**
9mth	90%	**1.25**
12mth	100%	**1.38**

Catchment Divide	
Length	Slope
0	2125
113	2111
171	2110
263	2105
565	2084
618	2082

Equal Area Slope	
Start RL	2118
End RL	2082
Slope %	5.83

Velocity Calculation	
Distance (m)	618
Time (minutes)	15.6
Velocity (m/s)	0.66



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CIVIL AND STRUCTURAL

INITIAL PEAK FLOW CALCULATIONS FOR RURAL CATCHMENTS

Based on QUDM 4.00 'Catchment Hydrology'

Written by BB 14/08/09

Job Number: **13119**
Job Name: **Oakleigh West Mine Rehabilitation**
Catchment 10
Designed: KR
Checked:

IFD : Ipswich

TOTAL RUNOFF COEFF.

No.	Area (Ha)	C10	Total C10
1	29.31	0.70	
2			
3			
4			
5			
6			
7			
8			
9			
10			
	29.31		**0.70**

EXISTING TIME OF CONCENTRATION

Bransby-Williams Equation	Channel Slope (%)	3
	Flow Length (km)	1.155
	Area (Ha)	29.31
	Travel Time (min)	38.36
Modified Friends Equation	Channel Slope (%)	3
	Flow Length (km)	1.155
	Area (Ha)	29.31
	Left Bank Slope (1 in __)	4
	Right Bank Slope (1 in __)	4
	Base width (m)	10
	Assumed Flood Depth (m)	0.5
	Stream Slope (1=uniform, 0=variable)	0
	Mannings 'n'	0.05
	Wetted Perimeter (m)	14.12
	Channel area (m2)	6.00
	Travel Time	26.32
	Total Time (Tc)	**32.3**

Please note:
User Data to be placed in the Green Cells only

PEAK RUNOFF CALCULATIONS

ARI Storm (yr)	Rainfall Intensity (mm/hr)	Coeficient of Runoff	Peak Runoff Rates (m^3/s)
1	50	0.56	**2.26**
2	65	0.60	**3.13**
5	84	0.67	**4.57**
10	97	0.70	**5.52**
20	114	0.74	**6.79**
50	136	0.81	**8.93**
100	154	0.84	**10.55**

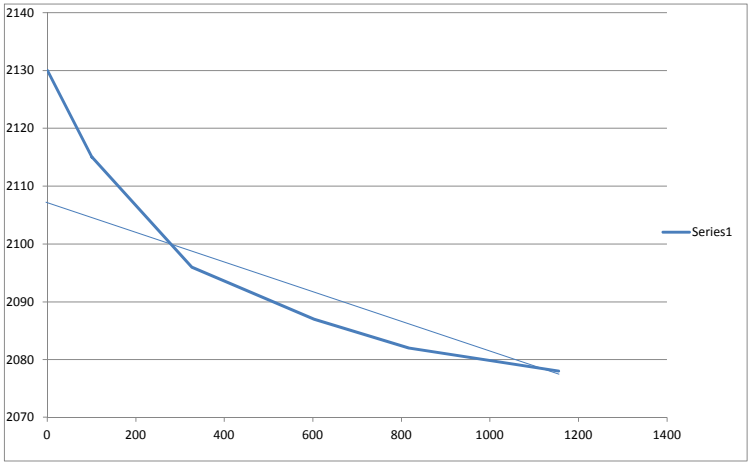
PEAK FLOWS FOR FREQUENT EVENTS

ARI Storm (yr)	Percentage of Q1 (%)	Peak Runoff Rates (m^3/s)
1mth	25%	**0.57**
2mth	40%	**0.91**
3mth	50%	**1.13**
4mth	60%	**1.36**
6mth	75%	**1.70**
9mth	90%	**2.04**
12mth	100%	**2.26**

Catchment Divide	
Length	Slope
0	2130
101	2115
326	2096
603	2087
817	2082
1155	2078

Equal Area Slope	
Start RL	2108
End RL	2078
Slope %	2.60

Velocity Calculation	
Distance (m)	1155
Time (minutes)	32.3
Velocity (m/s)	0.60



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CIVIL AND STRUCTURAL

INITIAL PEAK FLOW CALCULATIONS FOR RURAL CATCHMENTS

Based on QUDM 4.00 'Catchment Hydrology'

Written by BB 14/08/09

Job Number: **13119**
Job Name: **Oakleigh West Mine Rehabilitation**
Catchment 11
Designed: KR
Checked:

IFD : Ipswich

TOTAL RUNOFF COEFF.

No.	Area (Ha)	C10	Total C10
1	8.82	0.70	
2			
3			
4			
5			
6			
7			
8			
9			
10			
	8.82		**0.70**

EXISTING TIME OF CONCENTRATION

Bransby-Williams Equation	Channel Slope (%)	5
	Flow Length (km)	0.307
	Area (Ha)	8.82
	Travel Time (min)	10.38
Modified Friends Equation	Channel Slope (%)	5
	Flow Length (km)	0.307
	Area (Ha)	8.82
	Left Bank Slope (1 in __)	4
	Right Bank Slope (1 in __)	4
	Base width (m)	10
	Assumed Flood Depth (m)	0.5
	Stream Slope (1=uniform, 0=variable)	0
	Mannings 'n'	0.05
	Wetted Perimeter (m)	14.12
	Channel area (m2)	6.00
	Travel Time	6.43
	Total Time (Tc)	**8.4**

Please note:
User Data to be placed in the Green Cells only

PEAK RUNOFF CALCULATIONS

ARI Storm (yr)	Rainfall Intensity (mm/hr)	Coeficient of Runoff	Peak Runoff Rates (m^3/s)
1	95	0.56	**1.30**
2	123	0.60	**1.79**
5	158	0.67	**2.57**
10	179	0.70	**3.07**
20	208	0.74	**3.75**
50	247	0.81	**4.88**
100	278	0.84	**5.72**

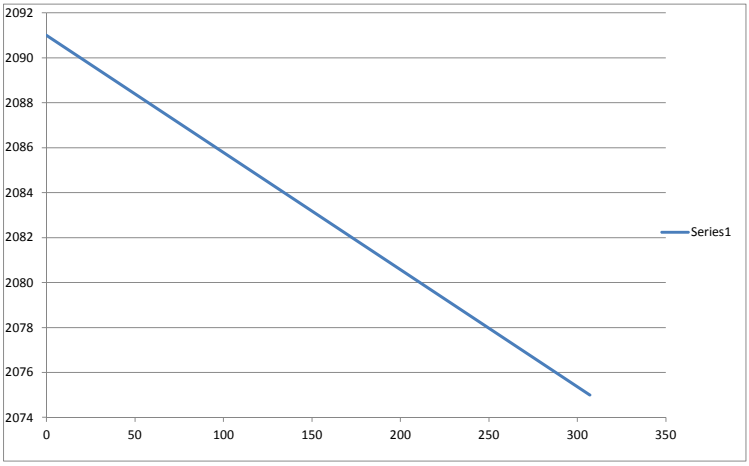
PEAK FLOWS FOR FREQUENT EVENTS

ARI Storm (yr)	Percentage of Q1 (%)	Peak Runoff Rates (m^3/s)
1mth	25%	**0.33**
2mth	40%	**0.52**
3mth	50%	**0.65**
4mth	60%	**0.78**
6mth	75%	**0.98**
9mth	90%	**1.17**
12mth	100%	**1.30**

Catchment Divide	
Length	Slope
0	2091
307	2075

Equal Area Slope	
Start RL	2091
End RL	2075
Slope %	5.21

Velocity Calculation	
Distance (m)	307
Time (minutes)	8.4
Velocity (m/s)	0.61



CALCULATE THE FLOW IN AN OPEN CHANNEL

Job Name: **Oakleigh Mine Rehabilitation**

Job Number: **13119**

Location *Rock Lined Channel Catchment 1*

	Steepest Grade	*Flattest Grade*
CHANNEL PROPERTIES		
Manning's roughness n	0.050	0.050
LEFT hand side slope (horiz / vert)	4	4
RIGHT hand side slope (horiz / vert)	4	4
BED SLOPE (vertical/horizontal)	0.240	0.045
Design BED WIDTH (metres)	4	4
Design flow	4.60	4.60
THE RESULTANT DEPTH	0.26	0.41
LENGTH of the Channel (m)	100	100
Velocity (m/sec)	3.5	2.0
Vel * Depth	0.9	0.8
Time of Flow (minutes)	0.5	0.8

CALCULATE THE FLOW IN AN OPEN CHANNEL

Job Name: **Oakleigh Mine Rehabilitation**

Job Number: **13119**

Location *Rock Lined Channel Catchment 2*

Steepest Grade

CHANNEL PROPERTIES

Manning's roughness n	0.050
LEFT hand side slope (horiz / vert)	4
RIGHT hand side slope (horiz / vert)	4
BED SLOPE (vertical/horizontal)	0.140
Design BED WIDTH (metres)	4
Design flow	5.80
THE RESULTANT DEPTH	0.34
LENGTH of the Channel (m)	100
Velocity (m/sec)	3.1
Vel * Depth	1.1
Time of Flow (minutes)	0.5

Flattest Grade

CHANNEL PROPERTIES

Manning's roughness n	0.050
LEFT hand side slope (horiz / vert)	4
RIGHT hand side slope (horiz / vert)	4
BED SLOPE (vertical/horizontal)	0.032
Design BED WIDTH (metres)	4
Design flow	5.80
THE RESULTANT DEPTH	0.51
LENGTH of the Channel (m)	100
Velocity (m/sec)	1.9
Vel * Depth	1.0
Time of Flow (minutes)	0.9

CALCULATE THE FLOW IN AN OPEN CHANNEL

Job Name: **Oakleigh Mine Rehabilitation**

Job Number: **13119**

Location *Rock Lined Channel Catchment 6*

Steepest Grade

CHANNEL PROPERTIES

Manning's roughness n	0.050
LEFT hand side slope (horiz / vert)	4
RIGHT hand side slope (horiz / vert)	4
BED SLOPE (vertical/horizontal)	0.140
Design BED WIDTH (metres)	4
Design flow	6.36
THE RESULTANT DEPTH	0.36
LENGTH of the Channel (m)	100
Velocity (m/sec)	3.2
Vel * Depth	1.2
Time of Flow (minutes)	0.5

Flattest Grade

CHANNEL PROPERTIES

Manning's roughness n	0.050
LEFT hand side slope (horiz / vert)	4
RIGHT hand side slope (horiz / vert)	4
BED SLOPE (vertical/horizontal)	0.066
Design BED WIDTH (metres)	4
Design flow	6.36
THE RESULTANT DEPTH	0.44
LENGTH of the Channel (m)	100
Velocity (m/sec)	2.5
Vel * Depth	1.1
Time of Flow (minutes)	0.7

CALCULATE THE FLOW IN AN OPEN CHANNEL

Job Name: **Oakleigh Mine Rehabilitation**

Job Number: **13119**

Location *Rock Lined Channel Catchment 8*

Steepest Grade

CHANNEL PROPERTIES

Manning's roughness n	0.050
LEFT hand side slope (horiz / vert)	4
RIGHT hand side slope (horiz / vert)	4
BED SLOPE (vertical/horizontal)	0.160
Design BED WIDTH (metres)	2
Design flow	2.07
THE RESULTANT DEPTH	0.26
LENGTH of the Channel (m)	100
Velocity (m/sec)	2.6
Vel * Depth	0.7
Time of Flow (minutes)	0.6

Flattest Grade

CHANNEL PROPERTIES

Manning's roughness n	0.050
LEFT hand side slope (horiz / vert)	4
RIGHT hand side slope (horiz / vert)	4
BED SLOPE (vertical/horizontal)	0.110
Design BED WIDTH (metres)	2
Design flow	2.07
THE RESULTANT DEPTH	0.29
LENGTH of the Channel (m)	100
Velocity (m/sec)	2.3
Vel * Depth	0.7
Time of Flow (minutes)	0.7

CALCULATE THE FLOW IN AN OPEN CHANNEL

Job Name: **Oakleigh Mine Rehabilitation**

Job Number: **13119**

Location *Stay Turf Catchment 3*

	Steepest Grade	*Flattest Grade*
CHANNEL PROPERTIES		
Manning's roughness n	0.040	0.040
LEFT hand side slope (horiz / vert)	4	4
RIGHT hand side slope (horiz / vert)	4	4
BED SLOPE (vertical/horizontal)	0.015	0.027
Design BED WIDTH (metres)	20	20
Design flow	18.40	18.40
THE RESULTANT DEPTH	0.48	0.40
LENGTH of the Channel (m)	100	100
Velocity (m/sec)	1.8	2.1
Vel * Depth	0.8	0.9
Time of Flow (minutes)	0.9	0.8

CALCULATE THE FLOW IN AN OPEN CHANNEL

Job Name: **Oakleigh Mine Rehabilitation**

Job Number: **13119**

Location *Stay Turf Catchment 4*

Steepest Grade		*Flattest Grade*	
CHANNEL PROPERTIES		CHANNEL PROPERTIES	
Manning's roughness n	0.040	Manning's roughness n	0.040
LEFT hand side slope (horiz / vert)	4	LEFT hand side slope (horiz / vert)	4
RIGHT hand side slope (horiz / vert)	4	RIGHT hand side slope (horiz / vert)	4
BED SLOPE (vertical/horizontal)	0.062	BED SLOPE (vertical/horizontal)	0.042
Design BED WIDTH (metres)	10	Design BED WIDTH (metres)	10
Design flow	6.28	Design flow	6.28
THE RESULTANT DEPTH	0.25	THE RESULTANT DEPTH	0.28
LENGTH of the Channel (m)	100	LENGTH of the Channel (m)	100
Velocity (m/sec)	2.3	Velocity (m/sec)	2.0
Vel * Depth	0.6	Vel * Depth	0.6
Time of Flow (minutes)	0.7	Time of Flow (minutes)	0.8

CALCULATE THE FLOW IN AN OPEN CHANNEL

Job Name: **Oakleigh Mine Rehabilitation**

Job Number: **13119**

Location *Stay Turf Catchment 5*

Steepest Grade

CHANNEL PROPERTIES

Manning's roughness n	0.040
LEFT hand side slope (horiz / vert)	4
RIGHT hand side slope (horiz / vert)	4
BED SLOPE (vertical/horizontal)	0.037
Design BED WIDTH (metres)	20
Design flow	22.10
THE RESULTANT DEPTH	0.41
LENGTH of the Channel (m)	100
Velocity (m/sec)	2.5
Vel * Depth	1.0
Time of Flow (minutes)	0.7

Flattest Grade

CHANNEL PROPERTIES

Manning's roughness n	0.040
LEFT hand side slope (horiz / vert)	4
RIGHT hand side slope (horiz / vert)	4
BED SLOPE (vertical/horizontal)	0.021
Design BED WIDTH (metres)	20
Design flow	22.10
THE RESULTANT DEPTH	0.48
LENGTH of the Channel (m)	100
Velocity (m/sec)	2.1
Vel * Depth	1.0
Time of Flow (minutes)	0.8

CALCULATE THE FLOW IN AN OPEN CHANNEL

Job Name: **Oakleigh Mine Rehabilitation**

Job Number: **13119**

Location *Stay Turf Catchment 7*

Steepest Grade

CHANNEL PROPERTIES

Manning's roughness n	0.040
LEFT hand side slope (horiz / vert)	4
RIGHT hand side slope (horiz / vert)	4
BED SLOPE (vertical/horizontal)	0.030
Design BED WIDTH (metres)	10
Design flow	6.21
THE RESULTANT DEPTH	0.30
LENGTH of the Channel (m)	100
Velocity (m/sec)	1.8
Vel * Depth	0.6
Time of Flow (minutes)	0.9

Flattest Grade

CHANNEL PROPERTIES

Manning's roughness n	0.040
LEFT hand side slope (horiz / vert)	4
RIGHT hand side slope (horiz / vert)	4
BED SLOPE (vertical/horizontal)	0.022
Design BED WIDTH (metres)	10
Design flow	6.21
THE RESULTANT DEPTH	0.33
LENGTH of the Channel (m)	100
Velocity (m/sec)	1.6
Vel * Depth	0.5
Time of Flow (minutes)	1.0

CALCULATE THE FLOW IN AN OPEN CHANNEL

Job Name: **Oakleigh Mine Rehabilitation**

Job Number: **13119**

Location *Stay Turf Catchment 9*

Steepest Grade

CHANNEL PROPERTIES

Manning's roughness n	0.040
LEFT hand side slope (horiz / vert)	4
RIGHT hand side slope (horiz / vert)	4
BED SLOPE (vertical/horizontal)	0.100
Design BED WIDTH (metres)	10
Design flow	6.23
THE RESULTANT DEPTH	0.21
LENGTH of the Channel (m)	100
Velocity (m/sec)	2.7
Vel * Depth	0.6
Time of Flow (minutes)	0.6

Flattest Grade

CHANNEL PROPERTIES

Manning's roughness n	0.040
LEFT hand side slope (horiz / vert)	4
RIGHT hand side slope (horiz / vert)	4
BED SLOPE (vertical/horizontal)	0.040
Design BED WIDTH (metres)	10
Design flow	6.23
THE RESULTANT DEPTH	0.28
LENGTH of the Channel (m)	100
Velocity (m/sec)	2.0
Vel * Depth	0.6
Time of Flow (minutes)	0.8

CALCULATE THE FLOW IN AN OPEN CHANNEL

Job Name: **Oakleigh Mine Rehabilitation**

Job Number: **13119**

Location *Stay Turf Catchment 10*

Steepest Grade		*Flattest Grade*	
CHANNEL PROPERTIES		CHANNEL PROPERTIES	
Manning's roughness n	0.040	Manning's roughness n	0.040
LEFT hand side slope (horiz / vert)	4	LEFT hand side slope (horiz / vert)	4
RIGHT hand side slope (horiz / vert)	4	RIGHT hand side slope (horiz / vert)	4
BED SLOPE (vertical/horizontal)	0.025	BED SLOPE (vertical/horizontal)	0.020
Design BED WIDTH (metres)	20	Design BED WIDTH (metres)	20
Design flow	10.55	Design flow	10.55
THE RESULTANT DEPTH	0.30	THE RESULTANT DEPTH	0.32
LENGTH of the Channel (m)	100	LENGTH of the Channel (m)	100
Velocity (m/sec)	1.7	Velocity (m/sec)	1.6
Vel * Depth	0.5	Vel * Depth	0.5
Time of Flow (minutes)	1.0	Time of Flow (minutes)	1.1

CALCULATE THE FLOW IN AN OPEN CHANNEL

Job Name: **Oakleigh Mine Rehabilitation**

Job Number: **13119**

Location *Stay Turf Catchment 11*

Steepest Grade

CHANNEL PROPERTIES

Manning's roughness n	0.040
LEFT hand side slope (horiz / vert)	4
RIGHT hand side slope (horiz / vert)	4
BED SLOPE (vertical/horizontal)	0.066
Design BED WIDTH (metres)	10
Design flow	5.72
THE RESULTANT DEPTH	0.23
LENGTH of the Channel (m)	100
Velocity (m/sec)	2.3
Vel * Depth	0.5
Time of Flow (minutes)	0.7

Flattest Grade

CHANNEL PROPERTIES

Manning's roughness n	0.040
LEFT hand side slope (horiz / vert)	4
RIGHT hand side slope (horiz / vert)	4
BED SLOPE (vertical/horizontal)	0.052
Design BED WIDTH (metres)	10
Design flow	5.72
THE RESULTANT DEPTH	0.25
LENGTH of the Channel (m)	100
Velocity (m/sec)	2.1
Vel * Depth	0.5
Time of Flow (minutes)	0.8