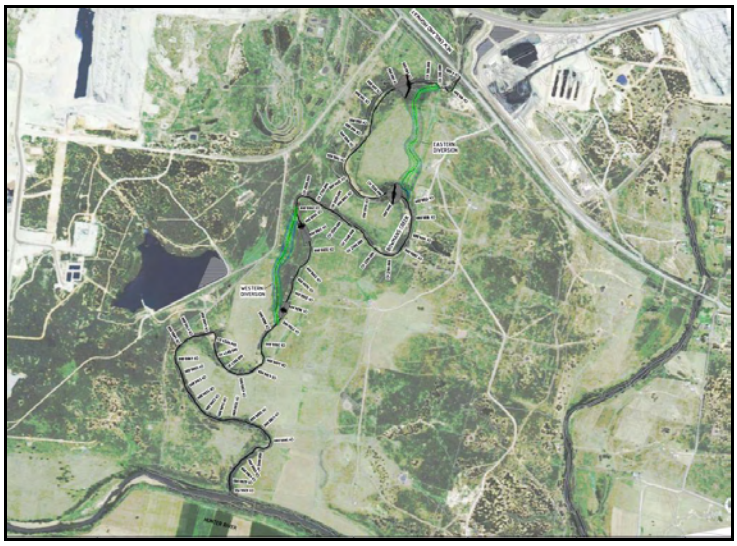
Appendix 6 Flood Study



Flood Study

Bowmans Creek Diversion

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Ashton Coal

Bowmans Creek Diversion

Flood Study

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Report No	DN00171	
Date	28 September 2009	
Revision	3	

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Executive Summary

This report presents a flood assessment of Bowmans Creek that has been carried out:

- for Ashton Coal in support of proposed Creek diversion works near Camberwell, approximately 15 kilometres north west of Singleton in the Hunter Valley;
- to meet the Director General's (*Section 75W of the Environmental Planning and Assessment Act 1979)* requirement under Application Number DA 309-11-2001 MOD 6, for, "a detailed assessment of the potential impacts of the project, using appropriate quantitative modelling on flooding".

The proposed works are to maximise long wall coal yields and involves diverting two sections of Bowmans Creek as indicated below.

Proposed Creek Diversion Locations

Based on flood frequency analysis (FFA) flows, a rainfall runoff model of the catchment was developed to generate flow hydrographs. These hydrographs served as inputs to an integrated one dimension / two dimensional model of the Bowmans Creek channel and floodplain, extending from the New England Highway downstream to its confluence with the Hunter River.

Existing Conditions

Existing floodplain conditions were initially modelled using TUFLOW, a two dimensional hydrodynamic model that accounts for flows in channels and across floodplains. Flow regime figures for 1 year, 5 year, 20 year and 100 year ARIs (with low Hunter River flood levels), and a 100 year ARI Hunter flood combined with a 1 year flood in Bowmans Creek are included in Annexure C. In general, the results indicate:

- flows are generally contained within bank along Bowmans Creek in the 1 year ARI event with only local minor breakouts occurring locally at several upstream 'remnant meanders' in the 5 year ARI. Major breakout flows extending through overbank areas occur in events greater than the 20 year ARI.
- velocities within the Bowmans Creek main channel generally vary from about 1.5m/s to 2.0m/s in the 1 year ARI event, except at the upstream end of the site through the New England Highway bridge where velocities are shown to be greater than 2.0m/s. In the 100 year ARI event the main channel velocites generally vary from about 2.6m/s to 3.8m/s, although increasing to greater than 4.0m/s under the Highway bridge. The higher velocities through the bridge waterway are consistent with observed scouring that occurred during the June 2007 flood event.
- The existing Bowmans Creek system is subject to scouring as the result of high channel velocities, particularly in the vicinity of the New England Highway bridge and in its lower reach towards the Hunter River.

In addition to the Bowmans Creek modelling that adopts low Hunter River flood levels, an assessment was carried out with the Hunter River representing the 1955 peak water level (of approximately 64.2mAHD) coincident with Bowmans Creek 1 year 12 hour ARI flows. Compared with low Hunter River water level conditions, the results indicate a drowning out of the Bowmans Creek system by the Hunter River flows with associated velocity decreases along the Bowmans Creek channel. The Hunter River influence extends upstream almost to the New England Highway, but without influencing flow regimes through the bridge waterway.

Proposed Conditions

The existing conditions TUFLOW model was subsequently adjusted to include two proposed diversion sections of Bowmans Creek. In association with the proposed diversion channels, four block banks (total) are proposed within the existing main channel. These banks are located near the upstream and downstream confluences of the proposed diversions with the existing channel. The block banks near the:

- upstream of the diversions are to divert flows away from the existing channel and into the proposed diversion;
- downstream of the diversions are to limit flows from backing upstream into the existing channels where main channel flows are required to bypass.

The TUFLOW model has also been adjusted to incorporate predicted land surface subsidence representing the ‘ultimate’ condition following extraction of four seams over a period of about 15 years resulting in worst case subsidences of up to 8.3m on the floodplain (with no subsequent filling to create a free draining landscape).

Diversion work and block bank locations and geometry are included in Annexure B. Flow regime figures for 1 year, 5 year, 20 year and 100 year average recurrence intervals (with low Hunter River flood levels), and a single 100 year ARI Hunter flood assessment are included in Annexure D. The results indicate:

- The proposed diversions in association with the proposed block banks would generally contain Bowmans Creek flows within bank up to approximately the 5 year ARI event with flood levels and velocities similar to existing conditions.
- Local narrow shaping in the upstream of the proposed Eastern Diversion channel has been introduced in conjunction with an extended overbank section of block bank to limit upstream velocities and flood levels in the vicinity of the New England Highway bridge to approximately that of existing conditions. Table 2 in the main report gives a comparison of existing condition and proposed diversion works flow regimes at this location. Table 3 in the main report summarises typical velocities in the proposed diversion channels.
- The subsidence zones would collect local tributary flows in frequent small events, with the block banks and diversion channels conveying the main channel flows of Bowmans Creek.
- Variable subsidence of up to 0.5m is expected along a 500m length of the existing channel just upstream of the western diversion. To limit potential for breakout flows from the main channel into subsidence areas to the south a local diversion bund (on the overbank floodplain area) that would reinstate existing ground levels has been included in the TUFLOW model.
- In events larger than the 5 year ARI the block banks and existing channel sections are overtopped with flows entering the subsided zones. In these larger events the increase in floodplain storage would be significant and result in the attenuation of flows entering the Hunter River.

Comments and Conclusions

With respect to flood flow regimes we highlight the following.

- The configuration of the proposed eastern and western diversion channels and associated block banks would have minimal impact on existing system within bank capacities, however there is expected to be some increased velocities within the diversion channels compared to the existing channel (in the adjacent length of channel under exiting conditions).
- It is understood that geomorphic design of the diversion channels is to be based upon these velocities and consequent bed shear stress analysis.
- Undisturbed channel lengths downstream of the proposed diversions can be expected to have some velocity increase in channel lengths just downstream of the diversions.
- The land surface subsidence associated with the proposed underground mining will significantly increase floodplain storage introducing pondage areas that will capture flows from local tributaries in small frequent events, and significantly attenuate peak flows entering the Hunter River in larger events such as the 20 year and 100 year ARI.
- Management of the subsidence zones should take into account batter slopes and protection against scouring from flood flows entering these zones. This should be assessed at the time of subsidence.

The local diversion bund of approximately 30m length and up to 0.4m high on the minor floodplain water run within the central creek meander, included in the proposed conditions TUFLOW model, is only required in the event of subsidence happening within this area. To avoid potential adverse impacts on flow regimes (compared to existing conditions) any such local filling on the floodplain should be limited to reinstating subsided ground levels to no higher than existing (pre-subsided) levels.

1 Introduction

This report presents a flood assessment of Bowmans Creek that has been carried out:

- for Ashton Coal in support of proposed Creek diversion works near Camberwell, approximately 15 kilometres north west of Singleton in the Hunter Valley;
- to meet the Director General's (*Section 75W of the Environmental Planning and Assessment Act 1979)* requirement under Application Number DA 309-11-2001 MOD 6, for, "a detailed assessment of the potential impacts of the project, using appropriate quantitative modelling on flooding".

The proposed works are to maximise long wall coal yields and involves diverting two sections of Bowmans Creek as indicated in Figure 1.

Figure 1: Proposed Creek Diversion Locations

This flood study includes assessment of:

- existing flood flow regimes from upstream of the New England Highway downstream along Bowmans Creek to its the junction with the Hunter River; and
- flood flow regimes and changes along Bowmans Creek (from the New England Highway downstream to its the junction with the Hunter River) with the proposed diversions in place.

Catchment flows have been quantified using flood frequency analysis and by development of a rainfall runoff model using RAFTS software with floodplain flow regimes modelled using TUFLOW 1D/2D hydrodynamic software.

2 Data Base

The following information has formed the data base for this flood assessment.

- Australian Rainfall and Runoff (2000).
- A previous diversion option report, 'Ashton Mine Project, Camberwell, Proposed Diversion of Bowmans Creek' (Issue No.2 October 2001) prepared by Patterson Britton & Partners Pty Ltd for White Mining Limited.
- 'Ashton Coal South East Open Cut Project Surface Water Assessment' (3 July 2009) prepared by Worley Parsons for Ashton Coal Operations Pty Limited.
- A digital terrain model based on aerial laser survey (dated 2007) provided by Ashton Coal Operations Pty Limited.
- Ground survey sections along and across Bowmans Creek (04.08.08) provided by Ashton Coal Operations Pty Limited.
- Ashton Underground Mine East and West Creek Diversions – Option 9 Diversion Corridors (22/06/09).
- Predicted subsidence ground surface levels provided by Ashton Coal Operations Pty Limited.
- Dimensions of local culverts within the site provided by Ashton Coal Operations Pty Limited.
- Site inspection during the course of this study.
- Report by Fluvial Systems, 'Bowmans Creek Diversion Flood Hydrology and Geomorphology', dated 25 Septenber 2009.

3 Catchment Description

The Bowmans Creek catchment (upstream of the Hunter River) covers an area of 262km^2 and is outlined in Figure 2. Bowmans Creek is sourced in mountainous areas with peaks up to approximately 800mAHD. The central creek system generally flows in a southerly direction to its confluence with the Hunter River some 56km downstream, where typical elevations are approximately 60mAHD. About 8km^2 of local catchments drain to Bowmans Creek between the New England Highway and the Hunter River.

The catchment is predominantly cleared rural pasture land although, the Ravensworth State Forest, which is located in the central section of the catchment, covers approximately 5% of the total catchment area. In the low lying downstream areas of the catchment, mining activities have altered land surfaces and impacted on Bowmans Creek and its associated tributaries and floodplains. The Asthon Coal site is located within the very downstream meandering floodplain area of the catchment.

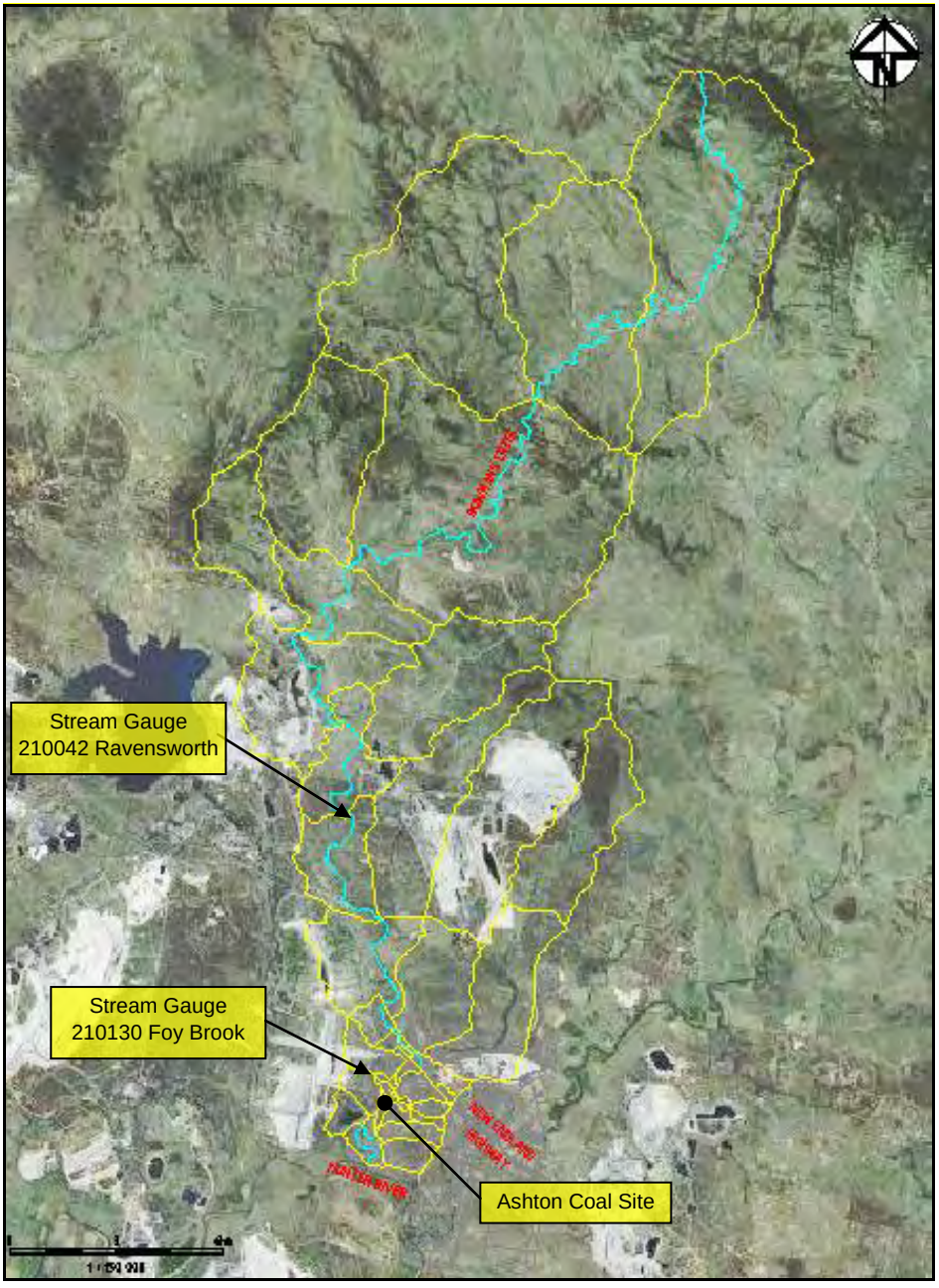

Figure 2: Bowmans Creek Catchment (see Annexure A for further detail)

4 Hydrologic Assessment

4.1 Flood Frequency Analysis

4.1.1 Bowmans Creek

Flood frequency analysis (FFA) of the Bowmans Creek has been carried out by Fluvial Systems Pty Ltd during the course of this study based on two gauges with up to 43 years of recorded stream data. The FFA indicates a generally reliable estimate for flows up to about a 10 year ARI although less reliable for larger less frequent events. This said, the FFA analysis is considered more representative of larger design flow frequencies than uncalibrated catchment rainfall modelling or use of the Rural Rational Method in accordance with Australian Rainfall and Runoff (as discussed in the Flood Hydrology and Geomorphology report).

The FFA flow estimates are summarised in Table 1.

4.1.2 Hunter River

The FFA carried out by Fluvial Systems Pty Ltd also examines Hunter River impacts of Bowmans Creek and comments that, *'Under conditions of very large Hunter River floods, Bowman's Creek will be inundated by Hunter River water. However, Bowmans Creek typically peaks one day before the Hunter River, so the Creek will still experience the hydraulic conditions imposed by high flows in Bowmans Creek itself.'*

The 'very large' Hunter floods that would inundate the Bowmans Creek floodplain are estimated in the FFA report to be greater than about a 7 year ARI.

4.2 Catchment Rainfall Runoff Modelling

4.2.1 Methodology

RAFTS software was used to develop a catchment rainfall runoff model capable of generating full runoff hydrographs to serve as inputs for modelling of the Bowmans Creek floodplain.

With only a single daily rain gauge (at Grenell Homestead) located some 60km from the site in the extreme upper north west of the catchment, and no pluviometers on the catchment or in nearby areas, formal model calibration has not been possible. As discussed in the Flood Hydrology and Geomorphology report the FFA is considered a more reliable method of estimating Bowmans Creek flows than alternatives such as the Rational Method or simply adopting the RAFTS software default 'storage coefficient multiplication factor' (of Bx = 1.0). Hence, the 'storage coefficient multiplication factor' was adjusted within the RAFTS catchment model (see Table 1) to generate peak flows that approximate FFA flows for the 1 year, 5 year, 20 year and 100 year average recurrence interval (ARI) events. Using this process a range of storm durations were modelled (from 2hrs to 24hrs) to identify peak flow hydrographs for the assessed recurrence intervals.

The RAFTS model subareas and parameters are summarised in Annexure A. Model 'vectored' slopes have been calculated in accordance with recommended RAFTS model technical procedures, and initial and continuing losses adopted in accordance with Australian Rainfall and Runoff estimates.

4.2.2 Results

The adopted catchment flows at the New England Highway bridge are summarised in Table 1. The 12 hour and 18 hour duration storms were found to result in the peak flows at the bridge. RAFTS model summary outputs are included in Annexure A.

Table 1: Peak Flows at New England Highway Bridge

Flood Event (ARI)	Flood Frequency Analysis (m^3/s) (Approx. 1.5km downstream of bridge) *	RAFTS Model		TUFLOW Model
		Flow (m^3/s)	Global Factor	Flow (m^3/s) (At downstream of bridge)
1 year [12hr]	62	62	Bx=2.3	62
5 year [18hr]	153	155	Bx=3.0	155
20 year [18hr]	324	322	Bx=2.5	318
100 year [12hr]	721	753	Bx=1.3	700

[ ] indicates storm duration that generated peak flow.

* FFA for "Extended DS Bowmans Br series (1956 – 2009)" refer to Appendix 7.

The lower 20 year and 100 year ARI peak flow estimates generated using TUFLOW (compared with the RAFTS modelling) is a result of flow attenuation on the floodplain assessed within TUFLOW (and not in RAFTS). TUFLOW model results are more fully discussed in the following sections of this report.

5 Hydraulic Assessment

5.1 Methodology

TUFLOW software has been used to develop a floodplain model of Bowmans Creek flood flow regimes. TUFLOW is a computational engine that provides two-dimensional and one-dimensional solutions of the free-surface flow equations that simulate flood and tidal wave propagation. For assessing Bowmans Creek it is specifically beneficial since the hydrodynamic behaviour of the meandering channel system and its interaction with the overbank floodplain has complex 2D flow patterns that would be awkward to represent using traditional 1D network models.

As shown by the shading on Figure 3, the TUFLOW model extends from just upstream of the New England Highway downstream through the site to its confluence with the Hunter River. The model has been built using the following inputs.

- A digital terrain model based on aerial laser survey provided by Ashton Coal. This has been used to represent the general floodplain with a 5m model grid.
- Thirty five ground survey sections across Bowmans Creek provided by Ashton Coal. These sections have been incorporated into the model to represent the main Bowmans Creek waterway as a one dimension waterway. The section locations and geometry are included in Annexure B.
- Bowmans Creek Bridge Drawing (WAE), (included in Annexure B).
- Dimensions of local culverts within the modelled floodplain.
- Site inspection during the course of this study to determine waterway and floodplain characteristics.
- Catchment runoff hydrographs generated from the abovementioned RAFTS modelling (input locations are included in Annexure B).

5.1.1 Hunter River Modelling

Hunter River flooding significantly impacts on Bowmans Creek. As noted in an earlier report, 'Ashton Mine Project, Camberwell, Proposed Diversion of Bowmans Creek' (October 2001), the 1955 Hunter River water level of 64.2mAHD (adopted as a 100 year ARI event) extends upstream beyond the New England Highway bridge crossing of Bowmans Creek.

Furthermore, the FFA (included in the Hydrology and Geomorphology report) and a recent surface water assessment on the neighbouring Glennies Creek ('Ashton Coal South East Open Cut Project Surface Water Assessment', 3 July 2009) indicates that flooding on the Hunter River is likely to occur relatively independently to that in Glennies Creek. Such independence is also considered likely for the Hunter River and Bowmans Creek as the Bowmans Creek catchment is even smaller than the Glennies Creek catchment.

Since the occurrence of high Hunter River flood levels is likely to be independent from Bowmans Creek flooding and because Hunter River flooding would tend to mask flow regime changes on Bowmans Creek resulting from the proposed diversions (e.g. flood levels and extents, floodplain storage, velocities and hydrograph), the hydraulic assessment primarily focuses on Bowmans Creek flow regimes with low level Hunter River levels. However the independence of Bowmans Creek flooding and Hunter River flooding is with respect to the timing of peak water levels, and that the storm event conditions are producing similar recurrence interval flows (with less than a 10% areal reduction indicated in Australian Rainfall and Runoff) on each waterway within a 24 hour window of time. This being the case, in addition to the above assessment, potential impacts resulting from the proposed diversion works during

coincident Hunter River and Bowmans Creek flooding are examined assuming 100 year flood levels occurring on the Hunter River coincident with 1 year ARI flows on Bowmans Creek, and comparing existing conditions with the proposed diversion conditions.

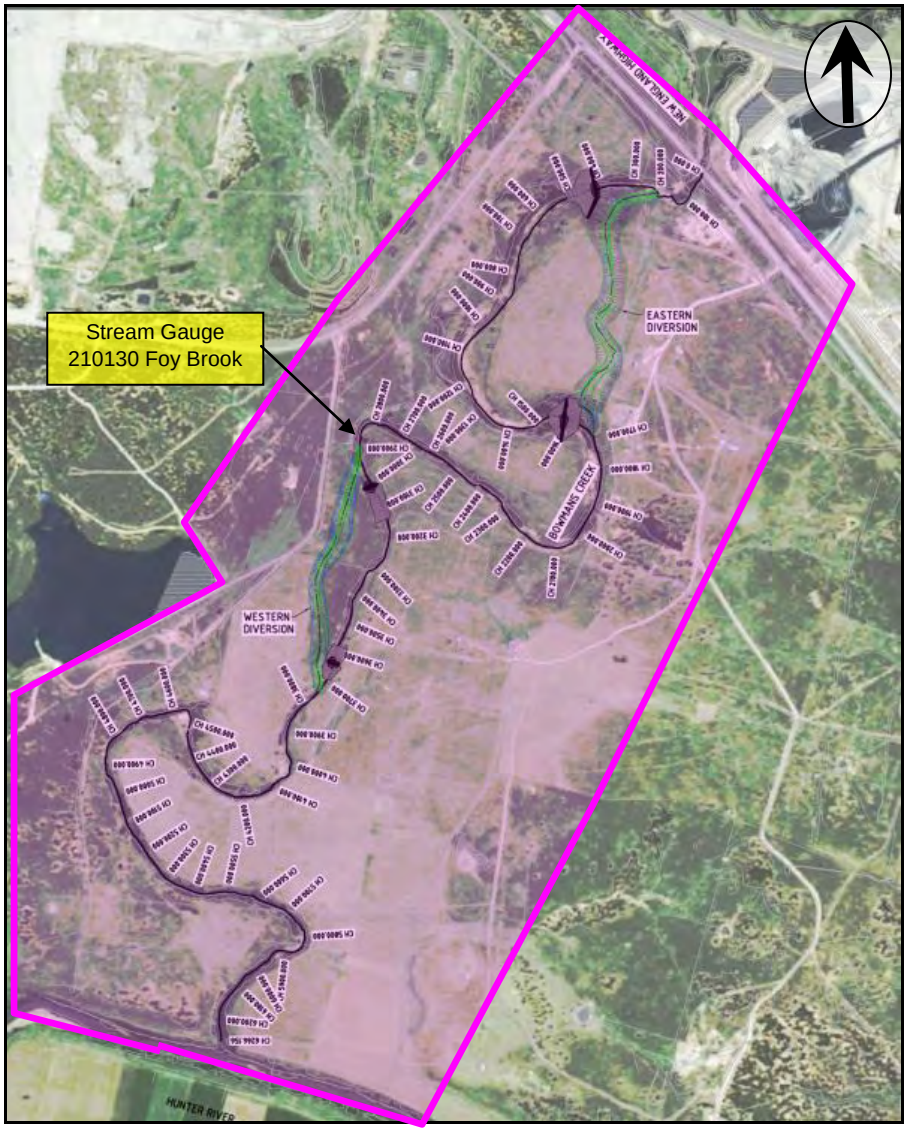

Figure 3: Approximate Extent of Floodplain Modelling
(see results figures in Annexures C and D for further detail)

5.2 Existing Conditions

5.2.1 Bowmans Creek

Adopted waterway and floodplain roughnesses and inflow hydrograph locations used in the TUFLOW modelling of the existing conditions are included in Annexure B. Predominantly a roughness of n = 0.04 has been adopted as representative of both the within bank channel and the broad open grass floodplain areas.

Existing condition flow regimes for Bowmans Creek are presented in Annexure C, and represent 1 year, 5 year, 20 year and 100 ARI events for low water levels in the Hunter River. The results indicate that:

- flows are generally contained within bank along Bowmans Creek in the 1 year ARI event with only local minor breakouts occurring locally at several upstream 'remnant meanders'

in the 5 year ARI. Major breakout flows extending through overbank areas occur in events greater than the 20 year ARI. In the 100 year ARI event such breakout flows are most significant in the 1km length of floodplain immediately downstream of the New England Highway bridge, and generally limited to within the width of the meandering corridor with depths of up to 2m on the floodplain.

- velocities within the Bowmans Creek main channel generally vary from about 1.5m/s to 2.0m/s in the 1 year ARI event, except at the upstream end of the site through the New England Highway bridge where velocities are shown to be greater than 2.0m/s. In the 100 year ARI event the main channel velocities generally vary from about 2.6m/s to 3.8m/s, although increasing to greater than 4.0m/s under the Highway bridge. The higher velocities through the bridge waterway are consistent with observed scouring that occurred during the June 2007 flood event.
- the existing Bowmans Creek system is subject to scouring as the result of high channel velocities, particularly in the vicinity of the New England Highway bridge and in its lower reach towards the Hunter River. This is evident from both the hydraulic assessment and field inspection carried out during the process of this study, and creek survey undertaken in 2006 and 2008 by Pegasus Technical.

5.2.2 Hunter River Flood Impacts

In addition to the above noted Bowmans Creek modelling that adopts low Hunter River flood levels, a flow hydrograph was introduced on the Hunter River to represent the 1955 peak water level in the Hunter River (of approximately 64.2mAHD) coincident with Bowmans Creek 1 year 12hour ARI flows. The resulting flow regime for this condition is included in Annexure C. Compared with low Hunter River water level conditions the results indicate a drowning out of the Bowmans Creek system by the Hunter River flows with associated velocity decreases along the Bowmans Creek channel. The Hunter River influence extends upstream almost to the New England Highway, but without influencing flow regimes through the bridge waterway.

5.3 Proposed Diversion Conditions

Figure 4 indicates the future underground mining layout which identifies corridors for two proposed diversions (referred to as the Eastern and Western Diversions) that are to facilitate the proposed mining processes.

Eastern Diversion - This diversion is located just downstream of the New England Highway and so as to protect nearby significant aboriginal artefacts. The diversion is to sit between the proposed Long Wall 4 (LW4) and Long Wall 6B (LW6B), and extend for approximately 900m before linking back into the existing creek alignment

Western Diversion - This diversion is located downstream and to the west of the northern diversion. It is to sit south of proposed Long Wall 8 (LW8) and west of Mini Wall 7 (MW7) and Long Wall 7A (LW7A), extending approximately 800m before linking back into the existing creek.

5.3.1 Assessment Methodology

The existing conditions TUFLOW model was adjusted to include the two proposed diversion sections of Bowmans Creek. Section locations and geometry are included in Annexure B. In association with the proposed diversion channels, four block banks (total) are proposed within the existing main channel. These banks are located near the upstream and downstream confluences of the proposed diversions with the existing channel. Block bank locations and geometry are included in Annexure B.

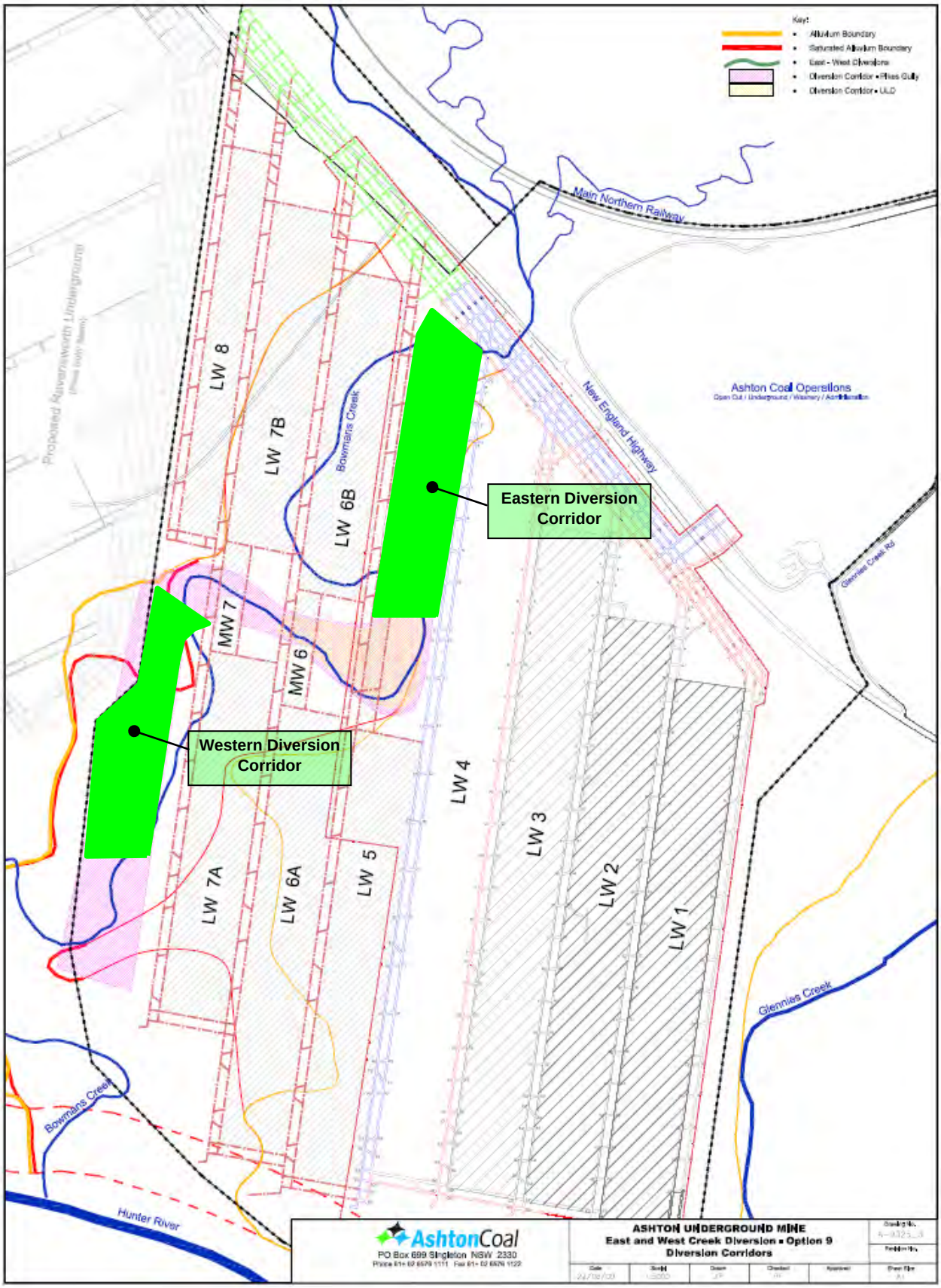

Figure 4: Proposed Diversion Corridors

The block banks near the:

- upstream of the diversions are to divert flows away from the existing channel and into the proposed diversion;
- downstream of the diversions are to limit flows from backing upstream into the existing channels where main channel flows are required to bypass.

The TUFLOW model represents the diversions as one dimensional waterways, with cross sections representing the diversion alignments, geometry and vegetation detailing prepared by Fluvial Systems Pty Ltd during the course of this assessment. Channel roughnesses for the diversions as shown in Annexure B and are typically n=0.04 in the low flow portion off the channel, n=0.1 in proposed heavily vegetated zones, and n=0.06 on the channel batters up to the existing ground levels.

The TUFLOW model has also been adjusted to incorporate predicted land surface subsidence representing the worst case 'ultimate' condition following extraction of four seams over a period of about 15 years resulting in subsidences of up to 8.3m on the floodplain with no subsequent filling of the subsidence areas (to create a free draining landscape).

5.3.2 Results

Flood flow regimes for the proposed diversion conditions are discussed below. Flow regime figures for 1 year, 5 year, 20 year and 100 year ARIs (with low Hunter River flood levels), and a single 100 year ARI Hunter flood assessment are included in Annexure D.

Hydraulic Performance of Proposed Diversions

Modelling of the proposed diversions indicates that they would generally contain Bowmans Creek flows within bank up to approximately the 5 year ARI event with flood levels similar to existing conditions, and some velocity changes as discussed below.

Interaction between Diversions and Existing Creek

The four proposed block banks have been configured to divert up to approximately the 5 year ARI flow (representing the within bank capacity of the existing channel) before allowing spill from the main channel flows into the existing Bowmans Creek alignment.

Local narrow shaping (representing equivalent existing channel waterway area) in the upstream of the proposed Eastern Diversion channel has been introduced in conjunction with an extended overbank section of block bank. These features limit upstream velocities and flood levels in the vicinity of the New England Highway bridge to approximately that of existing conditions. Table 2 gives a comparison of existing condition and proposed diversion works flow regimes at this location.

Table 2: Comparison of Flow Regimes at Downstream of New England Highway

Catchment Condition	Average Recurrence Interval											
	1 year			5 year			20 year			100 year		
	WL (mAHD)	Q (m^3/s)	V (m/s)	WL (mAHD)	Q (m^3/s)	V (m/s)	WL (mAHD)	Q (m^3/s)	V (m/s)	WL (mAHD)	Q (m^3/s)	V (m/s)
Existing	64.2	62	2.6	65.2	155	2.6	66.1	318	2.8	67.3	700	4.3
Proposed	63.9	62	2.9	65.1	155	3.0	66.0	318	3.1	67.1	708	4.5
Change	-0.3	0	0.3	-0.1	0	0.4	-0.1	0	0.3	-0.2	8	0.2

A comparison of Bowmans Creek velocities within the channel corridor is presented in Table 3. The results indicate that there would be an increase in velocities within the diversion channel compared to the existing channel (in the adjacent length of channel under exiting conditions). Undisturbed channel lengths downstream of the proposed diversions can be expected to have some velocity increase in channel lengths just downstream of the diversions (as shown on the TUFLOW model result figures just downstream of the eastern diversion), diminishing to no increase further downstream as indicated in the Table 3 Sections BI and BV1 (section location figures are included in Annexure B).

Table 3: Comparison of Channel Velocities

Location	Section Label	Catchment Condition	Velocities (m/s)			
			1 year	5 year	20 year	100 year
Zone of Eastern Diversion	BD	Existing	**1.1**	**1.6**	**2.0**	**2.6**
	E9	Proposed	**2.0**	**3.7**	**3.0**	**4.1**
Downstream of Eastern Diversion	BI	Existing	1.4	1.9	2.4	2.8
	BI	Proposed	1.2	1.7	2.0	2.5
Zone of Western Diversion	BP	Existing	**1.9**	**2.3**	**2.6**	**3.2**
	W15	Proposed	**3.3**	**3.2**	**3.4**	**3.6**
Downstream of Western Diversion	BV1	Existing	1.6	2.1	2.5	3.2
	BV1	Proposed	1.5	2.1	2.4	2.8

Refer to layout figure in Annexure B for Section locations.

Flood Regime with Creek Diversions and Mine Subsidence

The combined impact of the proposed diversions in conjunction with predicted subsidence zones (of up to some 8.3m) on flooding and flow regimes is seen in the TUFLOW model results figures included in the Annexure D.

The 1 year ARI figure in particular indicates that the subsidence zones would collect local tributary flows in frequent small events, with the block banks and diversion channels conveying the main channel flows of Bowmans Creek.

Variable subsidence of up to 0.5m is expected along a 500m length of the existing channel just upstream of the western diversion. This would introduce the potential for breakout flows from the main channel (in less than the 5 year ARI event) via a local water run and into the larger subsidence areas to the south. To contain flows within the main channel up to the 5 year ARI event a local diversion bund of approximately 30m length and up to 0.4m high is proposed on the minor floodplain water run (within the central Creek meander).

In events larger than the 5 year ARI the block banks and existing channel sections are overtopped with flows entering the subsided zones.

- In these larger events the increase in floodplain storage would be significant and result in the attenuation of flows entering the Hunter River. This impact is most clearly seen in the 100 year ARI assessment where peak flows of 708m^3/s enter the upstream of the floodplain under the New England Highway bridge, however this peak flow is reduced to 522m^3/s downstream of the subsidence areas as flows enter the Hunter River.
- The floodplain flow regimes in the south eastern portion of the site will be influenced by the subsidence with existing local water run flows being contained up to the 20 year ARI event, and in the 100 year event flows spilling out of the south eastern subsidence with a

greater magnitude than under exiting conditions. The change in the 100 year flow pattern adjacent to the Hunter River is expected to be of little significance since Hunter River flooding would inundate this area of the floodplain by an some additional 4 metres as discussed in Section 5.1.1 of this report.

- Subject to the proposed batter slopes on the subsidence zones velocities may be high and with the potential to result in scouring (as indicated in the model results at several specific locations). Any potential localised

6 Comments and Conclusions

In conclusion, with respect to flood flow regimes we highlight the following.

- The existing Bowmans Creek system is subject to scouring as the result of high channel velocities, particularly in the vicinity of the New England Highway bridge and in its lower reach towards the Hunter River.
- The configuration of the proposed eastern and western diversion channels and associated block banks would have minimal impact on existing system within bank capacities, however there is expected to be some increased velocities within the diversion channels compared to the existing channel (in the adjacent length of channel under exiting conditions).
- It is understood that geomorphic design of the diversion channels is to be based upon these velocities and consequent bed shear stress analysis.
- Undisturbed channel lengths downstream of the proposed diversions can be expected to have some velocity increase in channel lengths just downstream of the diversions.
- The land surface subsidence associated with the proposed underground mining will significantly increase floodplain storage introducing pondage areas that will capture flows from local tributaries in small frequent events, and significantly attenuate peak flows entering the Hunter River in larger events such as the 20 year and 100 year ARI.
- Management of the subsidence zones should take into account batter slopes and protection against scouring from flood flows entering these zones. This should be assessed at the time of subsidence. Any potential for increased local scour as a result of overland flow across steep slopes caused by subsidence could be mitigated by appropriate filling of the subsidence troughs.

The local diversion bund of approximately 30m length and up to 0.4m high on the minor floodplain water run within the central creek meander, included in the proposed conditions TUFLOW model, is only required in the event of subsidence happening within this area. To avoid potential adverse impacts on flow regimes (compared to existing conditions) any such local filling on the floodplain should be limited to reinstating subsided ground levels to no higher than existing (pre-subsided) levels.

Annexure A

RAFTS Model Input and Output Data

RAFTS Model Sub-catchment Plan

Summary inputs and outputs for 1 year, 5 year, 20 year and 100 year ARI events

Issue	Description	Date

0 1000 2000 3000 4000 5000m

1 : 50000

Client: ASHTON COAL

Status: **PRELIMINARY**
NOT TO BE USED FOR CONSTRUCTION

		Current Issue Signatures	
Scales	1:50000	Drawn	
Original Size	A1	Designed	
Height Datum	AHD	Checked	
Grid		Approved	

Filename: FIG_02-AA002659-NSD-00-CATCHMENT_PLAN_OVERALL.dwg

Project: BOWMANS CREEK CAMBERWELL

Title: BOWMANS CREEK CATCHMENT PLAN

HYDER CONSULTING PTY LTD
ABN 76 104 485 289
Level 5, 141 Walker St
North Sydney NSW 2060
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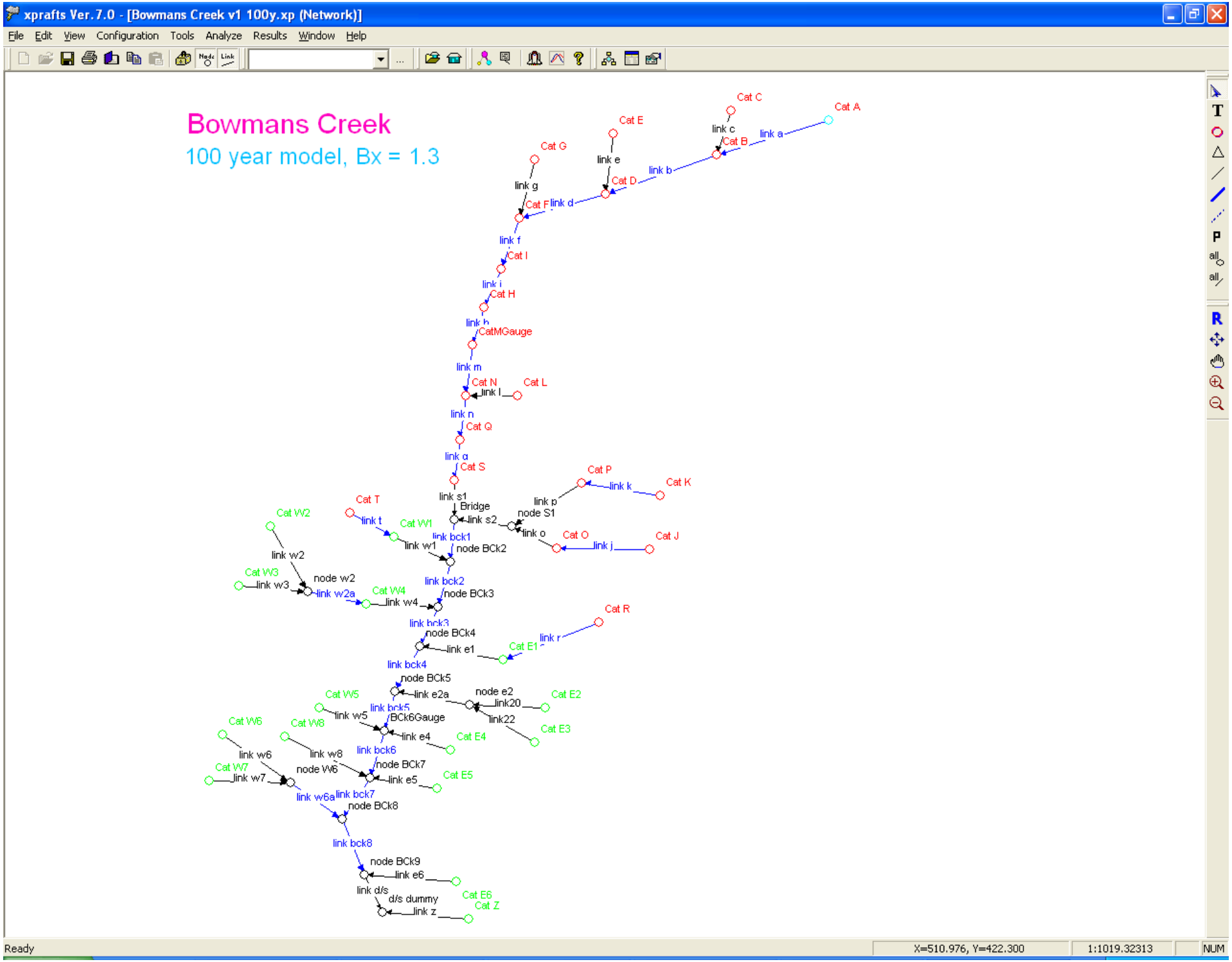
Drawing No.	Project No.	Issue
FIG. 02	AA002659	P1

100mm on Original

Date Plotted: 10 Sep 2009 - 10:55AM File Name: F:\AA002659\E-CAD\C-Civil\F-Figures\FIG_02-AA002659-NSD-00-CATCHMENT_PLAN_OVERALL.dwg V1


xprafts Ver.7.0 - [Bowmans Creek v1 100y.xp (Network)]
File Edit View Configuration Tools Analyze Results Window Help
Bowmans Creek
100 year model, Bx = 1.3
Cat A
Cat B
Cat C
Cat D
Cat E
Cat F
Cat G
Cat H
Cat I
CatMGauge
Cat L
Cat N
Cat O
Cat P
Cat Q
Cat R
Cat S
Cat T
Cat W1
Cat W2
Cat W3
Cat W4
Cat W5
Cat W6
Cat W7
Cat W8
Cat E1
Cat E2
Cat E3
Cat E4
Cat E5
Cat E6
Cat J
Cat K
Cat Z
link a
link b
link c
link d
link e
link f
link g
link i
link k
link l
link m
link n
link o
link p
link r
link s1
link s2
link t
link w1
link w2
link w2a
link w3
link w4
link w5
link w6
link w6a
link w7
link w8
link e1
link e2a
link e4
link e5
link e6
link20
link22
link j
link z
Bridge
node S1
node BCk2
node BCk3
node BCk4
node BCk5
node BCk7
node BCk8
node BCk9
node e2
node W6
node w2
BCk6Gauge
d/s dummy
link bck1
link bck2
link bck3
link bck4
link bck5
link bck6
link bck7
link bck8
link d/s
Ready
X=510.976, Y=422.300
1:1019.32313
NUM

Run started at: 6th July 2009   9:24:10

```
################################################################################
                        RUNTIME          RESULTS
################################################################################

Max. no. of links allowed =       1500
Max. no. of routng increments allowed =     250000
Max. no. of rating curve points =     250000
Max. no. of storm temporal points =     250000
Max. no. of channel subreaches =         25
Max link stack level =         25
Input Version number =          700

################################################################################
Bowmans Creek
Results for period from 12: 0.0 15/ 6/2009
                     to 10: 0.0 18/ 6/2009
################################################################################

                              ROUTING INCREMENT (MINS) =       7.00
                              STORM DURATION (MINS)    =       720.
                              RETURN PERIOD (YRS)      =         1.
                              BX                       =     2.3000
                              TOTAL OF FIRST SUB-AREAS  (ha) =   26246.00
                              TOTAL OF SECOND SUB-AREAS (ha) =       7.50
                              TOTAL OF ALL SUB-AREAS (ha)    =   26253.50
```

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2 (ha)	Slope #1 (%)	Slope #2 (%)	% Impervious #1 (%)	% Impervious #2 (%)	Pern #1	Pern #2	B #1	B #2	Link No.
Cat A	3229.0	0.000	2.300	0.000	0.000	0.000	.050	0.00	4.391	0.000	1.000
Cat C	3024.0	0.000	2.500	0.000	0.000	0.000	.050	0.00	4.071	0.000	2.000
Cat B	2300.0	0.000	3.200	0.000	0.000	0.000	.050	0.00	3.122	0.000	1.001
Cat E	1408.0	0.000	5.800	0.000	0.000	0.000	.050	0.00	1.797	0.000	3.000
Cat D	4156.0	0.000	1.800	0.000	0.000	0.000	.050	0.00	5.659	0.000	1.002
Cat G	713.00	0.000	4.400	0.000	0.000	0.000	.050	0.00	1.448	0.000	4.000
Cat F	685.00	0.000	1.500	0.000	0.000	0.000	.050	0.00	2.427	0.000	1.003
Cat I	1166.0	0.000	4.200	0.000	0.000	0.000	.050	0.00	1.914	0.000	1.004
Cat H	1197.0	0.000	2.100	0.000	0.000	0.000	.050	0.00	2.743	0.000	1.005
CatMGauge	565.00	0.000	.7000	0.000	0.000	0.000	.050	0.00	3.212	0.000	1.006
Cat L	1226.0	0.000	2.500	0.000	0.000	0.000	.050	0.00	2.546	0.000	5.000
Cat N	550.00	0.000	.6000	0.000	0.000	0.000	.050	0.00	3.420	0.000	1.007
Cat Q	644.00	0.000	1.100	0.000	0.000	0.000	.050	0.00	2.744	0.000	1.008
Cat S	186.00	0.000	.5000	0.000	0.000	0.000	.050	0.00	2.132	0.000	1.009
Cat K	1755.0	0.000	2.600	0.000	0.000	0.000	.050	0.00	3.008	0.000	6.000
Cat P	640.00	0.000	1.000	0.000	0.000	0.000	.050	0.00	2.868	0.000	6.001
Cat J	955.00	0.000	2.900	0.000	0.000	0.000	.050	0.00	2.076	0.000	7.000
Cat O	908.00	0.000	.6000	0.000	0.000	0.000	.050	0.00	4.439	0.000	7.001
node S1	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0018	0.000	6.002
Bridge	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0018	0.000	1.010
Cat T	28.500	0.000	.0500	0.000	0.000	0.000	.050	0.00	2.536	0.000	8.000
Cat W1	29.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	2.559	0.000	8.001
node BCk2	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0018	0.000	1.011
Cat W2	142.00	0.000	1.800	0.000	0.000	0.000	.050	0.00	.9778	0.000	9.000
Cat W3	7.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	1.222	0.000	10.00
node w2	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0047	0.000	9.001
Cat W4	15.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	1.816	0.000	9.002
node BCk3	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0018	0.000	1.012
Cat R	7.500	7.500	3.700	3.700	0.000	100.0	.050	.025	.1479	.0102	11.00
Cat E1	82.000	0.000	2.200	0.000	0.000	0.000	.050	0.00	.6649	0.000	11.00
node BCk4	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0018	0.000	1.013
Cat E2	41.000	0.000	3.000	0.000	0.000	0.000	.050	0.00	.3972	0.000	12.00
Cat E3	26.000	0.000	2.800	0.000	0.000	0.000	.050	0.00	.3244	0.000	13.00
node e2	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0047	0.000	12.00
node BCk5	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0018	0.000	1.014
Cat W5	20.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	2.109	0.000	14.00
Cat E4	41.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	3.064	0.000	15.00
BCk6Gauge	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0018	0.000	1.015
Cat E5	85.000	0.000	1.700	0.000	0.000	0.000	.050	0.00	.7704	0.000	16.00
Cat W8	17.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	1.938	0.000	17.00
node BCk7	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0018	0.000	1.016
Cat W6	98.000	0.000	2.100	0.000	0.000	0.000	.050	0.00	.7466	0.000	18.00
Cat W7	91.000	0.000	2.500	0.000	0.000	0.000	.050	0.00	.6585	0.000	19.00

node W6	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0047	0.000	18.00
node BCk8	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0018	0.000	1.017
Cat E6	95.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	4.743	0.000	20.00
node BCk9	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0018	0.000	1.018
Cat Z	114.00	0.000	1.970	0.000	0.000	0.000	.050	0.00	.8338	0.000	21.00
d/s dummy	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0047	0.000	1.019

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
Cat A	3.790	10.00	0.000	2.500	0.000	19.712	0.000	6.606	609.0	55.00
Cat C	3.790	10.00	0.000	2.500	0.000	19.712	0.000	6.690	609.0	0.000
Cat B	3.790	10.00	0.000	2.500	0.000	19.712	0.000	19.917	665.0	101.0
Cat E	3.790	10.00	0.000	2.500	0.000	19.712	0.000	7.287	609.0	0.000
Cat D	3.790	10.00	0.000	2.500	0.000	19.712	0.000	32.952	756.0	30.00
Cat G	3.790	10.00	0.000	2.500	0.000	19.712	0.000	3.647	609.0	0.000
Cat F	3.790	10.00	0.000	2.500	0.000	19.712	0.000	37.834	777.0	33.00
Cat I	3.790	10.00	0.000	2.500	0.000	19.712	0.000	42.318	791.0	10.00
Cat H	3.790	10.00	0.000	2.500	0.000	19.712	0.000	45.433	798.0	23.00
CatMGauge	3.790	10.00	0.000	2.500	0.000	19.712	0.000	46.319	819.0	39.00
Cat L	3.790	10.00	0.000	2.500	0.000	19.712	0.000	3.568	609.0	0.000
Cat N	3.790	10.00	0.000	2.500	0.000	19.712	0.000	50.552	861.0	27.00
Cat Q	3.790	10.00	0.000	2.500	0.000	19.712	0.000	51.851	889.0	21.00
Cat S	3.790	10.00	0.000	2.500	0.000	19.712	0.000	52.157	910.0	0.000
Cat K	3.790	10.00	0.000	2.500	0.000	19.712	0.000	4.816	609.0	5.000
Cat P	3.790	10.00	0.000	2.500	0.000	19.712	0.000	6.049	616.0	0.000
Cat J	3.790	10.00	0.000	2.500	0.000	19.712	0.000	3.357	609.0	8.000
Cat O	3.790	10.00	0.000	2.500	0.000	19.712	0.000	4.458	616.0	0.000
node S1	3.790	10.00	0.000	2.500	0.000	19.712	0.000	10.507	616.0	0.000
Bridge	3.790	10.00	0.000	2.500	0.000	19.712	0.000	62.114	889.0	3.000
Cat T	3.790	10.00	0.000	2.500	0.000	19.712	0.000	0.0165	609.0	3.000
Cat W1	3.790	10.00	0.000	2.500	0.000	19.712	0.000	0.0332	609.0	0.000
node BCk2	3.790	10.00	0.000	2.500	0.000	19.712	0.000	62.147	889.0	1.000
Cat W2	3.790	10.00	0.000	2.500	0.000	19.712	0.000	0.6719	609.0	0.000
Cat W3	3.790	10.00	0.000	2.500	0.000	19.712	0.000	.00582	609.0	0.000
node w2	3.790	10.00	0.000	2.500	0.000	19.712	0.000	0.6778	609.0	2.000
Cat W4	3.790	10.00	0.000	2.500	0.000	19.712	0.000	0.6894	609.0	0.000
node BCk3	3.790	10.00	0.000	2.500	0.000	19.712	0.000	62.638	889.0	1.000
Cat R	3.790	10.00	2.500	2.500	0.000	19.712	42.935	0.3788	420.0	4.000
Cat E1	3.790	10.00	0.000	2.500	0.000	19.712	0.000	0.7572	546.0	0.000
node BCk4	3.790	10.00	0.000	2.500	0.000	19.712	0.000	62.914	889.0	.5000
Cat E2	3.790	10.00	0.000	2.500	0.000	19.712	0.000	0.3540	595.0	0.000
Cat E3	3.790	10.00	0.000	2.500	0.000	19.712	0.000	0.2358	581.0	0.000
node e2	3.790	10.00	0.000	2.500	0.000	19.712	0.000	0.5890	595.0	0.000
node BCk5	3.790	10.00	0.000	2.500	0.000	19.712	0.000	63.036	889.0	2.000
Cat W5	3.790	10.00	0.000	2.500	0.000	19.712	0.000	0.0139	609.0	0.000
Cat E4	3.790	10.00	0.000	2.500	0.000	19.712	0.000	0.0207	609.0	0.000
BCk6Gauge	3.790	10.00	0.000	2.500	0.000	19.712	0.000	63.070	889.0	6.000
Cat E5	3.790	10.00	0.000	2.500	0.000	19.712	0.000	0.4402	609.0	0.000
Cat W8	3.790	10.00	0.000	2.500	0.000	19.712	0.000	0.0123	609.0	0.000
node BCk7	3.790	10.00	0.000	2.500	0.000	19.712	0.000	63.369	896.0	1.000
Cat W6	3.790	10.00	0.000	2.500	0.000	19.712	0.000	0.5800	609.0	0.000
Cat W7	3.790	10.00	0.000	2.500	0.000	19.712	0.000	0.6094	609.0	0.000
node W6	3.790	10.00	0.000	2.500	0.000	19.712	0.000	1.189	609.0	1.000
node BCk8	3.790	10.00	0.000	2.500	0.000	19.712	0.000	63.955	896.0	4.000
Cat E6	3.790	10.00	0.000	2.500	0.000	19.712	0.000	0.0343	616.0	0.000
node BCk9	3.790	10.00	0.000	2.500	0.000	19.712	0.000	63.990	903.0	0.000
Cat Z	3.790	10.00	0.000	2.500	0.000	19.712	0.000	0.6095	609.0	0.000
d/s dummy	3.790	10.00	0.000	2.500	0.000	19.712	0.000	64.339	903.0	0.000

Run completed at: 6th July 2009 9:24:13

Run started at: 22nd July 2009 11:29:56

##
RUNTIME RESULTS
##

Max. no. of links allowed = 1500
Max. no. of routng increments allowed = 250000
Max. no. of rating curve points = 250000
Max. no. of storm temporal points = 250000
Max. no. of channel subreaches = 25
Max link stack level = 25
Input Version number = 700

##
Bowmans Creek
Results for period from 12: 0.0 15/ 6/2009
to 14: 0.0 17/ 6/2009
##

ROUTING INCREMENT (MINS) = 5.00
STORM DURATION (MINS) = 1080.
RETURN PERIOD (YRS) = 5.
BX = 3.0000
TOTAL OF FIRST SUB-AREAS (ha) = 26246.00
TOTAL OF SECOND SUB-AREAS (ha) = 7.50
TOTAL OF ALL SUB-AREAS (ha) = 26253.50

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	#2	Slope #1 (%)	#2	% Impervious #1	#2	Perm #1	#2	B #1	#2	Link No.
Cat K	1755.0	0.000	2.600	0.000	0.000	0.000	.050	0.00	3.924	0.000	1.000
Cat P	640.00	0.000	1.000	0.000	0.000	0.000	.050	0.00	3.741	0.000	1.001
Cat J	955.00	0.000	2.900	0.000	0.000	0.000	.050	0.00	2.708	0.000	2.000
Cat O	908.00	0.000	.6000	0.000	0.000	0.000	.050	0.00	5.790	0.000	2.001
node S1	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0023	0.000	1.002
Cat E	1408.0	0.000	5.800	0.000	0.000	0.000	.050	0.00	2.345	0.000	3.000
Cat A	3229.0	0.000	2.300	0.000	0.000	0.000	.050	0.00	5.728	0.000	4.000
Cat C	3024.0	0.000	2.500	0.000	0.000	0.000	.050	0.00	5.310	0.000	5.000
Cat B	2300.0	0.000	3.200	0.000	0.000	0.000	.050	0.00	4.072	0.000	4.001
Cat D	4156.0	0.000	1.800	0.000	0.000	0.000	.050	0.00	7.381	0.000	3.001
Cat G	713.00	0.000	4.400	0.000	0.000	0.000	.050	0.00	1.889	0.000	6.000
Cat F	685.00	0.000	1.500	0.000	0.000	0.000	.050	0.00	3.166	0.000	3.002
Cat I	1166.0	0.000	4.200	0.000	0.000	0.000	.050	0.00	2.497	0.000	3.003
Cat H	1197.0	0.000	2.100	0.000	0.000	0.000	.050	0.00	3.578	0.000	3.004
CatMGauge	565.00	0.000	.7000	0.000	0.000	0.000	.050	0.00	4.189	0.000	3.005
Cat L	1226.0	0.000	2.500	0.000	0.000	0.000	.050	0.00	3.320	0.000	7.000
Cat N	550.00	0.000	.6000	0.000	0.000	0.000	.050	0.00	4.461	0.000	3.006
Cat Q	644.00	0.000	1.100	0.000	0.000	0.000	.050	0.00	3.579	0.000	3.007
Cat S	186.00	0.000	.5000	0.000	0.000	0.000	.050	0.00	2.780	0.000	3.008
Bridge	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0023	0.000	1.003
Cat T	28.500	0.000	.0500	0.000	0.000	0.000	.050	0.00	3.307	0.000	8.000
Cat W1	29.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	3.337	0.000	8.001
node BCk2	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0023	0.000	1.004
Cat W2	142.00	0.000	1.800	0.000	0.000	0.000	.050	0.00	1.275	0.000	9.000
Cat W3	7.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	1.594	0.000	10.00
node w2	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0062	0.000	9.001
Cat W4	15.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	2.369	0.000	9.002
node BCk3	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0023	0.000	1.005
Cat R	7.500	7.500	3.700	3.700	0.000	100.0	.050	.025	.1929	.0133	11.00
Cat E1	82.000	0.000	2.200	0.000	0.000	0.000	.050	0.00	.8672	0.000	11.00
node BCk4	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0023	0.000	1.006
Cat E2	41.000	0.000	3.000	0.000	0.000	0.000	.050	0.00	.5181	0.000	12.00
Cat E3	26.000	0.000	2.800	0.000	0.000	0.000	.050	0.00	.4231	0.000	13.00
node e2	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0062	0.000	12.00
node BCk5	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0023	0.000	1.007
Cat W5	20.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	2.751	0.000	14.00
Cat E4	41.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	3.996	0.000	15.00
BCk6Gauge	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0023	0.000	1.008
Cat E5	85.000	0.000	1.700	0.000	0.000	0.000	.050	0.00	1.004	0.000	16.00
Cat W8	17.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	2.528	0.000	17.00
node BCk7	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0023	0.000	1.009
Cat W6	98.000	0.000	2.100	0.000	0.000	0.000	.050	0.00	.9738	0.000	18.00
Cat W7	91.000	0.000	2.500	0.000	0.000	0.000	.050	0.00	.8589	0.000	19.00
node W6	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0062	0.000	18.00

node BCk8	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0023	0.000	1.010
Cat E6	95.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	6.186	0.000	20.00
node BCk9	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0023	0.000	1.011
Cat Z	114.00	0.000	1.970	0.000	0.000	0.000	.050	0.00	1.087	0.000	21.00
d/s dummy	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0062	0.000	1.012

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
Cat K	5.070	10.00	0.000	2.500	0.000	50.602	0.000	12.325	785.0	5.000
Cat P	5.070	10.00	0.000	2.500	0.000	50.602	0.000	15.422	790.0	0.000
Cat J	5.070	10.00	0.000	2.500	0.000	50.602	0.000	8.664	780.0	8.000
Cat O	5.070	10.00	0.000	2.500	0.000	50.602	0.000	11.420	790.0	0.000
node S1	5.070	10.00	0.000	2.500	0.000	50.602	0.000	26.842	790.0	0.000
Cat E	5.070	10.00	0.000	2.500	0.000	50.602	0.000	17.107	725.0	0.000
Cat A	5.070	10.00	0.000	2.500	0.000	50.602	0.000	17.294	905.0	55.00
Cat C	5.070	10.00	0.000	2.500	0.000	50.602	0.000	17.489	900.0	0.000
Cat B	5.070	10.00	0.000	2.500	0.000	50.602	0.000	51.482	840.0	101.0
Cat D	5.070	10.00	0.000	2.500	0.000	50.602	0.000	82.474	880.0	30.00
Cat G	5.070	10.00	0.000	2.500	0.000	50.602	0.000	8.853	725.0	0.000
Cat F	5.070	10.00	0.000	2.500	0.000	50.602	0.000	93.481	905.0	33.00
Cat I	5.070	10.00	0.000	2.500	0.000	50.602	0.000	104.49	885.0	10.00
Cat H	5.070	10.00	0.000	2.500	0.000	50.602	0.000	112.66	895.0	23.00
CatMGauge	5.070	10.00	0.000	2.500	0.000	50.602	0.000	114.98	920.0	39.00
Cat L	5.070	10.00	0.000	2.500	0.000	50.602	0.000	9.363	785.0	0.000
Cat N	5.070	10.00	0.000	2.500	0.000	50.602	0.000	125.97	960.0	27.00
Cat Q	5.070	10.00	0.000	2.500	0.000	50.602	0.000	129.31	985.0	21.00
Cat S	5.070	10.00	0.000	2.500	0.000	50.602	0.000	130.15	1005.	0.000
Bridge	5.070	10.00	0.000	2.500	0.000	50.602	0.000	154.92	1000.	3.000
Cat T	5.070	10.00	0.000	2.500	0.000	50.602	0.000	0.0388	910.0	3.000
Cat W1	5.070	10.00	0.000	2.500	0.000	50.602	0.000	0.0783	915.0	0.000
node BCk2	5.070	10.00	0.000	2.500	0.000	50.602	0.000	155.00	1005.	1.000
Cat W2	5.070	10.00	0.000	2.500	0.000	50.602	0.000	1.610	730.0	0.000
Cat W3	5.070	10.00	0.000	2.500	0.000	50.602	0.000	0.0168	905.0	0.000
node w2	5.070	10.00	0.000	2.500	0.000	50.602	0.000	1.626	730.0	2.000
Cat W4	5.070	10.00	0.000	2.500	0.000	50.602	0.000	1.651	735.0	0.000
node BCk3	5.070	10.00	0.000	2.500	0.000	50.602	0.000	156.14	1005.	1.000
Cat R	5.070	10.00	2.500	2.500	0.000	50.602	88.760	0.4936	420.0	4.000
Cat E1	5.070	10.00	0.000	2.500	0.000	50.602	0.000	1.507	665.0	0.000
node BCk4	5.070	10.00	0.000	2.500	0.000	50.602	0.000	156.71	1005.	.5000
Cat E2	5.070	10.00	0.000	2.500	0.000	50.602	0.000	0.7404	660.0	0.000
Cat E3	5.070	10.00	0.000	2.500	0.000	50.602	0.000	0.4833	660.0	0.000
node e2	5.070	10.00	0.000	2.500	0.000	50.602	0.000	1.224	660.0	0.000
node BCk5	5.070	10.00	0.000	2.500	0.000	50.602	0.000	157.02	1005.	2.000
Cat W5	5.070	10.00	0.000	2.500	0.000	50.602	0.000	0.0308	905.0	0.000
Cat E4	5.070	10.00	0.000	2.500	0.000	50.602	0.000	0.0503	905.0	0.000
BCk6Gauge	5.070	10.00	0.000	2.500	0.000	50.602	0.000	157.10	1005.	6.000
Cat E5	5.070	10.00	0.000	2.500	0.000	50.602	0.000	1.070	720.0	0.000
Cat W8	5.070	10.00	0.000	2.500	0.000	50.602	0.000	0.0278	905.0	0.000
node BCk7	5.070	10.00	0.000	2.500	0.000	50.602	0.000	157.74	1010.	1.000
Cat W6	5.070	10.00	0.000	2.500	0.000	50.602	0.000	1.311	710.0	0.000
Cat W7	5.070	10.00	0.000	2.500	0.000	50.602	0.000	1.345	665.0	0.000
node W6	5.070	10.00	0.000	2.500	0.000	50.602	0.000	2.648	680.0	1.000
node BCk8	5.070	10.00	0.000	2.500	0.000	50.602	0.000	159.05	985.0	4.000
Cat E6	5.070	10.00	0.000	2.500	0.000	50.602	0.000	0.1083	905.0	0.000
node BCk9	5.070	10.00	0.000	2.500	0.000	50.602	0.000	159.16	990.0	0.000
Cat Z	5.070	10.00	0.000	2.500	0.000	50.602	0.000	1.423	720.0	0.000
d/s dummy	5.070	10.00	0.000	2.500	0.000	50.602	0.000	160.03	985.0	0.000

Run completed at: 22nd July 2009 11:29:59

Run started at: 22nd July 2009 11:15:15

##
RUNTIME RESULTS
##

Max. no. of links allowed = 1500
Max. no. of routng increments allowed = 250000
Max. no. of rating curve points = 250000
Max. no. of storm temporal points = 250000
Max. no. of channel subreaches = 25
Max link stack level = 25
Input Version number = 700

##
Bowmans Creek
Results for period from 12: 0.0 15/ 6/2009
to 14: 0.0 17/ 6/2009
##

ROUTING INCREMENT (MINS) = 5.00
STORM DURATION (MINS) = 1080.
RETURN PERIOD (YRS) = 20.
BX = 2.5000
TOTAL OF FIRST SUB-AREAS (ha) = 26246.00
TOTAL OF SECOND SUB-AREAS (ha) = 7.50
TOTAL OF ALL SUB-AREAS (ha) = 26253.50

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	#2	Slope #1 (%)	#2	% Impervious #1	#2	Perm #1	#2	B #1	#2	Link No.
Cat A	3229.0	0.000	2.300	0.000	0.000	0.000	.050	0.00	4.773	0.000	1.000
Cat C	3024.0	0.000	2.500	0.000	0.000	0.000	.050	0.00	4.425	0.000	2.000
Cat B	2300.0	0.000	3.200	0.000	0.000	0.000	.050	0.00	3.393	0.000	1.001
Cat E	1408.0	0.000	5.800	0.000	0.000	0.000	.050	0.00	1.954	0.000	3.000
Cat D	4156.0	0.000	1.800	0.000	0.000	0.000	.050	0.00	6.151	0.000	1.002
Cat G	713.00	0.000	4.400	0.000	0.000	0.000	.050	0.00	1.574	0.000	4.000
Cat F	685.00	0.000	1.500	0.000	0.000	0.000	.050	0.00	2.638	0.000	1.003
Cat I	1166.0	0.000	4.200	0.000	0.000	0.000	.050	0.00	2.081	0.000	1.004
Cat H	1197.0	0.000	2.100	0.000	0.000	0.000	.050	0.00	2.981	0.000	1.005
CatMGauge	565.00	0.000	.7000	0.000	0.000	0.000	.050	0.00	3.491	0.000	1.006
Cat L	1226.0	0.000	2.500	0.000	0.000	0.000	.050	0.00	2.767	0.000	5.000
Cat N	550.00	0.000	.6000	0.000	0.000	0.000	.050	0.00	3.718	0.000	1.007
Cat Q	644.00	0.000	1.100	0.000	0.000	0.000	.050	0.00	2.982	0.000	1.008
Cat S	186.00	0.000	.5000	0.000	0.000	0.000	.050	0.00	2.317	0.000	1.009
Cat K	1755.0	0.000	2.600	0.000	0.000	0.000	.050	0.00	3.270	0.000	6.000
Cat P	640.00	0.000	1.000	0.000	0.000	0.000	.050	0.00	3.117	0.000	6.001
Cat J	955.00	0.000	2.900	0.000	0.000	0.000	.050	0.00	2.256	0.000	7.000
Cat O	908.00	0.000	.6000	0.000	0.000	0.000	.050	0.00	4.825	0.000	7.001
node S1	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0019	0.000	6.002
Bridge	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0019	0.000	1.010
Cat T	28.500	0.000	.0500	0.000	0.000	0.000	.050	0.00	2.756	0.000	8.000
Cat W1	29.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	2.781	0.000	8.001
node BCk2	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0019	0.000	1.011
Cat W2	142.00	0.000	1.800	0.000	0.000	0.000	.050	0.00	1.062	0.000	9.000
Cat W3	7.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	1.328	0.000	10.00
node w2	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0051	0.000	9.001
Cat W4	15.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	1.974	0.000	9.002
node BCk3	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0019	0.000	1.012
Cat R	7.500	7.500	3.700	3.700	0.000	100.0	.050	.025	.1607	.0111	11.00
Cat E1	82.000	0.000	2.200	0.000	0.000	0.000	.050	0.00	.7227	0.000	11.00
node BCk4	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0019	0.000	1.013
Cat E2	41.000	0.000	3.000	0.000	0.000	0.000	.050	0.00	.4317	0.000	12.00
Cat E3	26.000	0.000	2.800	0.000	0.000	0.000	.050	0.00	.3526	0.000	13.00
node e2	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0051	0.000	12.00
node BCk5	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0019	0.000	1.014
Cat W5	20.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	2.292	0.000	14.00
Cat E4	41.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	3.330	0.000	15.00
BCk6Gauge	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0019	0.000	1.015
Cat E5	85.000	0.000	1.700	0.000	0.000	0.000	.050	0.00	.8374	0.000	16.00
Cat W8	17.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	2.107	0.000	17.00
node BCk7	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0019	0.000	1.016
Cat W6	98.000	0.000	2.100	0.000	0.000	0.000	.050	0.00	.8115	0.000	18.00
Cat W7	91.000	0.000	2.500	0.000	0.000	0.000	.050	0.00	.7158	0.000	19.00
node W6	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0051	0.000	18.00

node BCk8	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0019	0.000	1.017
Cat E6	95.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	5.155	0.000	20.00
node BCk9	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0019	0.000	1.018
Cat Z	114.00	0.000	1.970	0.000	0.000	0.000	.050	0.00	.9063	0.000	21.00
d/s dummy	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0051	0.000	1.019

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
Cat A	6.810	10.00	0.000	2.500	0.000	78.657	0.000	40.320	785.0	55.00
Cat C	6.810	10.00	0.000	2.500	0.000	78.657	0.000	40.558	785.0	0.000
Cat B	6.810	10.00	0.000	2.500	0.000	78.657	0.000	117.18	785.0	101.0
Cat E	6.810	10.00	0.000	2.500	0.000	78.657	0.000	34.055	665.0	0.000
Cat D	6.810	10.00	0.000	2.500	0.000	78.657	0.000	179.35	880.0	30.00
Cat G	6.810	10.00	0.000	2.500	0.000	78.657	0.000	17.536	665.0	0.000
Cat F	6.810	10.00	0.000	2.500	0.000	78.657	0.000	199.60	850.0	33.00
Cat I	6.810	10.00	0.000	2.500	0.000	78.657	0.000	217.27	885.0	10.00
Cat H	6.810	10.00	0.000	2.500	0.000	78.657	0.000	234.44	890.0	23.00
CatMGauge	6.810	10.00	0.000	2.500	0.000	78.657	0.000	239.91	915.0	39.00
Cat L	6.810	10.00	0.000	2.500	0.000	78.657	0.000	20.789	765.0	0.000
Cat N	6.810	10.00	0.000	2.500	0.000	78.657	0.000	261.77	920.0	27.00
Cat Q	6.810	10.00	0.000	2.500	0.000	78.657	0.000	269.38	945.0	21.00
Cat S	6.810	10.00	0.000	2.500	0.000	78.657	0.000	271.34	965.0	0.000
Cat K	6.810	10.00	0.000	2.500	0.000	78.657	0.000	27.538	780.0	5.000
Cat P	6.810	10.00	0.000	2.500	0.000	78.657	0.000	35.011	785.0	0.000
Cat J	6.810	10.00	0.000	2.500	0.000	78.657	0.000	18.446	720.0	8.000
Cat O	6.810	10.00	0.000	2.500	0.000	78.657	0.000	24.804	740.0	0.000
node S1	6.810	10.00	0.000	2.500	0.000	78.657	0.000	59.632	785.0	0.000
Bridge	6.810	10.00	0.000	2.500	0.000	78.657	0.000	322.23	950.0	3.000
Cat T	6.810	10.00	0.000	2.500	0.000	78.657	0.000	0.1156	905.0	3.000
Cat W1	6.810	10.00	0.000	2.500	0.000	78.657	0.000	0.2330	910.0	0.000
node BCk2	6.810	10.00	0.000	2.500	0.000	78.657	0.000	322.46	955.0	1.000
Cat W2	6.810	10.00	0.000	2.500	0.000	78.657	0.000	3.237	665.0	0.000
Cat W3	6.810	10.00	0.000	2.500	0.000	78.657	0.000	0.0361	905.0	0.000
node w2	6.810	10.00	0.000	2.500	0.000	78.657	0.000	3.268	665.0	2.000
Cat W4	6.810	10.00	0.000	2.500	0.000	78.657	0.000	3.321	665.0	0.000
node BCk3	6.810	10.00	0.000	2.500	0.000	78.657	0.000	324.19	955.0	1.000
Cat R	6.810	10.00	2.500	2.500	0.000	78.657	120.08	0.7468	420.0	4.000
Cat E1	6.810	10.00	0.000	2.500	0.000	78.657	0.000	2.655	660.0	0.000
node BCk4	6.810	10.00	0.000	2.500	0.000	78.657	0.000	325.03	955.0	.5000
Cat E2	6.810	10.00	0.000	2.500	0.000	78.657	0.000	1.205	545.0	0.000
Cat E3	6.810	10.00	0.000	2.500	0.000	78.657	0.000	0.7827	545.0	0.000
node e2	6.810	10.00	0.000	2.500	0.000	78.657	0.000	1.988	545.0	0.000
node BCk5	6.810	10.00	0.000	2.500	0.000	78.657	0.000	325.48	955.0	2.000
Cat W5	6.810	10.00	0.000	2.500	0.000	78.657	0.000	0.0840	905.0	0.000
Cat E4	6.810	10.00	0.000	2.500	0.000	78.657	0.000	0.1422	905.0	0.000
BCk6Gauge	6.810	10.00	0.000	2.500	0.000	78.657	0.000	325.71	955.0	6.000
Cat E5	6.810	10.00	0.000	2.500	0.000	78.657	0.000	2.116	665.0	0.000
Cat W8	6.810	10.00	0.000	2.500	0.000	78.657	0.000	0.0695	905.0	0.000
node BCk7	6.810	10.00	0.000	2.500	0.000	78.657	0.000	326.67	960.0	1.000
Cat W6	6.810	10.00	0.000	2.500	0.000	78.657	0.000	2.521	665.0	0.000
Cat W7	6.810	10.00	0.000	2.500	0.000	78.657	0.000	2.457	660.0	0.000
node W6	6.810	10.00	0.000	2.500	0.000	78.657	0.000	4.978	660.0	1.000
node BCk8	6.810	10.00	0.000	2.500	0.000	78.657	0.000	328.48	955.0	4.000
Cat E6	6.810	10.00	0.000	2.500	0.000	78.657	0.000	0.2409	905.0	0.000
node BCk9	6.810	10.00	0.000	2.500	0.000	78.657	0.000	328.72	960.0	0.000
Cat Z	6.810	10.00	0.000	2.500	0.000	78.657	0.000	2.811	665.0	0.000
d/s dummy	6.810	10.00	0.000	2.500	0.000	78.657	0.000	329.93	960.0	0.000

Run completed at: 22nd July 2009 11:15:18

Run started at: 6th July 2009   9:25:27

##
                        RUNTIME   RESULTS
##

Max. no. of links allowed =   1500
Max. no. of routng increments allowed =   250000
Max. no. of rating curve points =   250000
Max. no. of storm temporal points =   250000
Max. no. of channel subreaches =   25
Max link stack level =   25
Input Version number =   700

##
Bowmans Creek

Results for period from 12: 0.0 15/ 6/2009
                     to 18: 0.0 16/ 6/2009
##

                                ROUTING INCREMENT (MINS) =   3.00
                                STORM DURATION (MINS)   =   720.
                                RETURN PERIOD (YRS)   =   100.
                                BX   =   1.3000
                                TOTAL OF FIRST SUB-AREAS (ha) =   26246.00
                                TOTAL OF SECOND SUB-AREAS (ha) =   7.50
                                TOTAL OF ALL SUB-AREAS (ha)   =   26253.50

     SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area (ha) #1	#2	Slope (%) #1	#2	% Impervious (%) #1	#2	Perm #1	#2	B #1	#2	Link No.
Cat A	3229.0	0.000	2.300	0.000	0.000	0.000	.050	0.00	2.482	0.000	1.000
Cat C	3024.0	0.000	2.500	0.000	0.000	0.000	.050	0.00	2.301	0.000	2.000
Cat B	2300.0	0.000	3.200	0.000	0.000	0.000	.050	0.00	1.764	0.000	1.001
Cat E	1408.0	0.000	5.800	0.000	0.000	0.000	.050	0.00	1.016	0.000	3.000
Cat D	4156.0	0.000	1.800	0.000	0.000	0.000	.050	0.00	3.198	0.000	1.002
Cat G	713.00	0.000	4.400	0.000	0.000	0.000	.050	0.00	.8188	0.000	4.000
Cat F	685.00	0.000	1.500	0.000	0.000	0.000	.050	0.00	1.371	0.000	1.003
Cat I	1166.0	0.000	4.200	0.000	0.000	0.000	.050	0.00	1.082	0.000	1.004
Cat H	1197.0	0.000	2.100	0.000	0.000	0.000	.050	0.00	1.550	0.000	1.005
CatMGauge	565.00	0.000	.7000	0.000	0.000	0.000	.050	0.00	1.815	0.000	1.006
Cat L	1226.0	0.000	2.500	0.000	0.000	0.000	.050	0.00	1.439	0.000	5.000
Cat N	550.00	0.000	.6000	0.000	0.000	0.000	.050	0.00	1.933	0.000	1.007
Cat Q	644.00	0.000	1.100	0.000	0.000	0.000	.050	0.00	1.551	0.000	1.008
Cat S	186.00	0.000	.5000	0.000	0.000	0.000	.050	0.00	1.205	0.000	1.009
Cat K	1755.0	0.000	2.600	0.000	0.000	0.000	.050	0.00	1.700	0.000	6.000
Cat P	640.00	0.000	1.000	0.000	0.000	0.000	.050	0.00	1.621	0.000	6.001
Cat J	955.00	0.000	2.900	0.000	0.000	0.000	.050	0.00	1.173	0.000	7.000
Cat O	908.00	0.000	.6000	0.000	0.000	0.000	.050	0.00	2.509	0.000	7.001
node S1	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0010	0.000	6.002
Bridge	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0010	0.000	1.010
Cat T	28.500	0.000	.0500	0.000	0.000	0.000	.050	0.00	1.433	0.000	8.000
Cat W1	29.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	1.446	0.000	8.001
node BCk2	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0010	0.000	1.011
Cat W2	142.00	0.000	1.800	0.000	0.000	0.000	.050	0.00	.5526	0.000	9.000
Cat W3	7.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	.6907	0.000	10.00
node w2	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0027	0.000	9.001
Cat W4	15.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	1.026	0.000	9.002
node BCk3	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0010	0.000	1.012
Cat R	7.500	7.500	3.700	3.700	0.000	100.0	.050	.025	.0836	.0057	11.00
Cat E1	82.000	0.000	2.200	0.000	0.000	0.000	.050	0.00	.3758	0.000	11.00
node BCk4	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0010	0.000	1.013
Cat E2	41.000	0.000	3.000	0.000	0.000	0.000	.050	0.00	.2245	0.000	12.00
Cat E3	26.000	0.000	2.800	0.000	0.000	0.000	.050	0.00	.1834	0.000	13.00
node e2	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0027	0.000	12.00
node BCk5	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0010	0.000	1.014
Cat W5	20.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	1.192	0.000	14.00
Cat E4	41.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	1.731	0.000	15.00
BCk6Gauge	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0010	0.000	1.015
Cat E5	85.000	0.000	1.700	0.000	0.000	0.000	.050	0.00	.4355	0.000	16.00
Cat W8	17.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	1.095	0.000	17.00
node BCk7	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0010	0.000	1.016
Cat W6	98.000	0.000	2.100	0.000	0.000	0.000	.050	0.00	.4220	0.000	18.00
Cat W7	91.000	0.000	2.500	0.000	0.000	0.000	.050	0.00	.3722	0.000	19.00

node W6	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0027	0.000	18.00
node BCk8	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0010	0.000	1.017
Cat E6	95.000	0.000	.0500	0.000	0.000	0.000	.050	0.00	2.680	0.000	20.00
node BCk9	.00001	0.000	.0200	0.000	0.000	0.000	.050	0.00	.0010	0.000	1.018
Cat Z	114.00	0.000	1.970	0.000	0.000	0.000	.050	0.00	.4713	0.000	21.00
d/s dummy	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0027	0.000	1.019

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
Cat A	11.800	10.00	0.000	2.500	0.000	106.09	0.000	123.82	600.0	55.00
Cat C	11.800	10.00	0.000	2.500	0.000	106.09	0.000	119.94	600.0	0.000
Cat B	11.800	10.00	0.000	2.500	0.000	106.09	0.000	332.25	600.0	101.0
Cat E	11.800	10.00	0.000	2.500	0.000	106.09	0.000	72.014	423.0	0.000
Cat D	11.800	10.00	0.000	2.500	0.000	106.09	0.000	483.14	696.0	30.00
Cat G	11.800	10.00	0.000	2.500	0.000	106.09	0.000	37.313	423.0	0.000
Cat F	11.800	10.00	0.000	2.500	0.000	106.09	0.000	516.21	675.0	33.00
Cat I	11.800	10.00	0.000	2.500	0.000	106.09	0.000	542.02	708.0	10.00
Cat H	11.800	10.00	0.000	2.500	0.000	106.09	0.000	574.91	648.0	23.00
CatMGauge	11.800	10.00	0.000	2.500	0.000	106.09	0.000	592.32	672.0	39.00
Cat L	11.800	10.00	0.000	2.500	0.000	106.09	0.000	53.316	570.0	0.000
Cat N	11.800	10.00	0.000	2.500	0.000	106.09	0.000	638.36	711.0	27.00
Cat Q	11.800	10.00	0.000	2.500	0.000	106.09	0.000	654.42	738.0	21.00
Cat S	11.800	10.00	0.000	2.500	0.000	106.09	0.000	658.78	759.0	0.000
Cat K	11.800	10.00	0.000	2.500	0.000	106.09	0.000	74.927	573.0	5.000
Cat P	11.800	10.00	0.000	2.500	0.000	106.09	0.000	98.550	579.0	0.000
Cat J	11.800	10.00	0.000	2.500	0.000	106.09	0.000	43.621	549.0	8.000
Cat O	11.800	10.00	0.000	2.500	0.000	106.09	0.000	66.496	582.0	0.000
node S1	11.800	10.00	0.000	2.500	0.000	106.09	0.000	165.04	579.0	0.000
Bridge	11.800	10.00	0.000	2.500	0.000	106.09	0.000	752.97	726.0	3.000
Cat T	11.800	10.00	0.000	2.500	0.000	106.09	0.000	0.4211	663.0	3.000
Cat W1	11.800	10.00	0.000	2.500	0.000	106.09	0.000	0.8518	666.0	0.000
node BCk2	11.800	10.00	0.000	2.500	0.000	106.09	0.000	753.81	729.0	1.000
Cat W2	11.800	10.00	0.000	2.500	0.000	106.09	0.000	6.979	423.0	0.000
Cat W3	11.800	10.00	0.000	2.500	0.000	106.09	0.000	0.1580	663.0	0.000
node w2	11.800	10.00	0.000	2.500	0.000	106.09	0.000	7.056	423.0	2.000
Cat W4	11.800	10.00	0.000	2.500	0.000	106.09	0.000	7.198	426.0	0.000
node BCk3	11.800	10.00	0.000	2.500	0.000	106.09	0.000	756.89	729.0	1.000
Cat R	11.800	10.00	2.500	2.500	0.000	106.09	139.10	1.636	420.0	4.000
Cat E1	11.800	10.00	0.000	2.500	0.000	106.09	0.000	6.438	423.0	0.000
node BCk4	11.800	10.00	0.000	2.500	0.000	106.09	0.000	758.07	729.0	.5000
Cat E2	11.800	10.00	0.000	2.500	0.000	106.09	0.000	2.951	423.0	0.000
Cat E3	11.800	10.00	0.000	2.500	0.000	106.09	0.000	2.009	423.0	0.000
node e2	11.800	10.00	0.000	2.500	0.000	106.09	0.000	4.960	423.0	0.000
node BCk5	11.800	10.00	0.000	2.500	0.000	106.09	0.000	758.64	729.0	2.000
Cat W5	11.800	10.00	0.000	2.500	0.000	106.09	0.000	0.3202	663.0	0.000
Cat E4	11.800	10.00	0.000	2.500	0.000	106.09	0.000	0.5606	663.0	0.000
BCk6Gauge	11.800	10.00	0.000	2.500	0.000	106.09	0.000	759.52	732.0	6.000
Cat E5	11.800	10.00	0.000	2.500	0.000	106.09	0.000	4.445	423.0	0.000
Cat W8	11.800	10.00	0.000	2.500	0.000	106.09	0.000	0.2858	663.0	0.000
node BCk7	11.800	10.00	0.000	2.500	0.000	106.09	0.000	761.04	738.0	1.000
Cat W6	11.800	10.00	0.000	2.500	0.000	106.09	0.000	5.484	423.0	0.000
Cat W7	11.800	10.00	0.000	2.500	0.000	106.09	0.000	5.497	423.0	0.000
node W6	11.800	10.00	0.000	2.500	0.000	106.09	0.000	10.981	423.0	1.000
node BCk8	11.800	10.00	0.000	2.500	0.000	106.09	0.000	763.42	738.0	4.000
Cat E6	11.800	10.00	0.000	2.500	0.000	106.09	0.000	0.9952	663.0	0.000
node BCk9	11.800	10.00	0.000	2.500	0.000	106.09	0.000	764.42	741.0	0.000
Cat Z	11.800	10.00	0.000	2.500	0.000	106.09	0.000	6.044	423.0	0.000
d/s dummy	11.800	10.00	0.000	2.500	0.000	106.09	0.000	766.01	741.0	0.000

Run completed at: 6th July 2009 9:25:30

IFD ANALYSIS BASED ON AUSTRALIAN RAINFALL & RUNOFF 1987

Site Name: Bowmans Creek Catchment

Geographical factor for 6 min 2 yr storm = 4.33
Geographical factor for 6 min 50 yr storm = 15.9
skewness = 0.19

2-year ARI, 1 hour intensity = 25.0 mm/hr
12 hour intensity = 5.0 mm/hr
72 hour intensity = 1.6 mm/hr

50-year ARI, 1 hour intensity = 44.3 mm/hr
12 hour intensity = 10.0 mm/hr
72 hour intensity = 3.2 mm/hr

IFD Table for Various ARIs and Duration

Duration (mins)	1 Year ARI (mm/h)	2 Year ARI (mm/h)	5 Year ARI (mm/h)	10 Year ARI (mm/h)	20 Year ARI (mm/h)	50 Year ARI (mm/h)	100 Year ARI (mm/h)
7	56	73	95	108	126	151	170
8	53	69	90	102	119	142	160
9	51	66	85	97	113	135	152
10	48.6	63	81	93	108	128	144
11	46.7	60	78	89	103	123	138
12	44.9	58	75	85	99	117	132
13	43.3	56	72	82	95	113	127
14	41.9	54	69	79	91	109	122
15	40.5	52	67	76	88	105	118
16	39.3	51	65	74	85	101	114
17	38.2	49.3	63	71	83	98	110
18	37.1	47.9	61	69	80	95	106
19	36.2	46.6	59	67	78	92	103
20	35.3	45.4	58	66	76	90	100
25	31.5	40.5	51	58	67	79	88
30	28.6	36.7	46.4	52	60	71	79
40	24.4	31.3	39.3	44.1	51	59	66
45	22.9	29.3	36.6	41	47.1	55	61
50	21.5	27.5	34.4	38.5	44.1	52	57
55	20.4	26	32.5	36.3	41.5	48.5	54
60	19.4	24.7	30.8	34.3	39.3	45.8	51
75	16.8	21.5	26.9	30.1	34.4	40.3	44.8
90	14.9	19.1	24	26.9	30.9	36.2	40.3
2.0 hours	12.4	15.9	20.1	22.6	26	30.5	34.1
3	9.48	12.2	15.5	17.5	20.3	23.9	26.8
4	7.84	10.1	12.9	14.7	17	20.1	22.6
6	5.99	7.76	10	11.4	13.3	15.8	17.8
8	4.95	6.43	8.34	9.53	11.1	13.3	15
9	4.58	5.95	7.75	8.86	10.3	12.4	14
10	4.28	5.56	7.25	8.3	9.7	11.6	13.1
11	4.02	5.23	6.83	7.82	9.15	11	12.4
12	3.79	4.94	6.46	7.41	8.68	10.4	11.8
13	3.46	4.5	5.89	6.76	7.92	9.49	10.7
14	3.19	4.16	5.44	6.24	7.31	8.77	9.92
18	2.98	3.88	5.07	5.82	6.81	8.17	9.24
20	2.79	3.64	4.76	5.46	6.39	7.67	8.67
22	2.64	3.43	4.49	5.16	6.04	7.24	8.19
24	2.5	3.26	4.26	4.89	5.72	6.86	7.77
30	2.18	2.84	3.71	4.26	4.99	5.98	6.77
36	1.94	2.53	3.31	3.8	4.45	5.33	6.03
42	1.76	2.29	3	3.44	4.03	4.83	5.46
48	1.61	2.1	2.74	3.15	3.69	4.42	5
54	1.49	1.94	2.53	2.91	3.4	4.08	4.62
60	1.38	1.8	2.36	2.7	3.16	3.79	4.29
66	1.29	1.68	2.2	2.53	2.96	3.55	4.01
72	1.21	1.58	2.07	2.37	2.78	3.33	3.77

Bowmans IFD Table.xls

Annexure B

TUFLOW Model Inputs

New England Highway Bridge WAE Drawing

Bowmans Creek Channel Layout & Sections Location Plan (including possible Local Block Bank)

Existing Section Shapes

Proposed Diversion Section Shapes

Proposed Block Bank (four total) Geometry

TUFLOW Roughnesses Figure

TUFLOW Inputs Location Plan

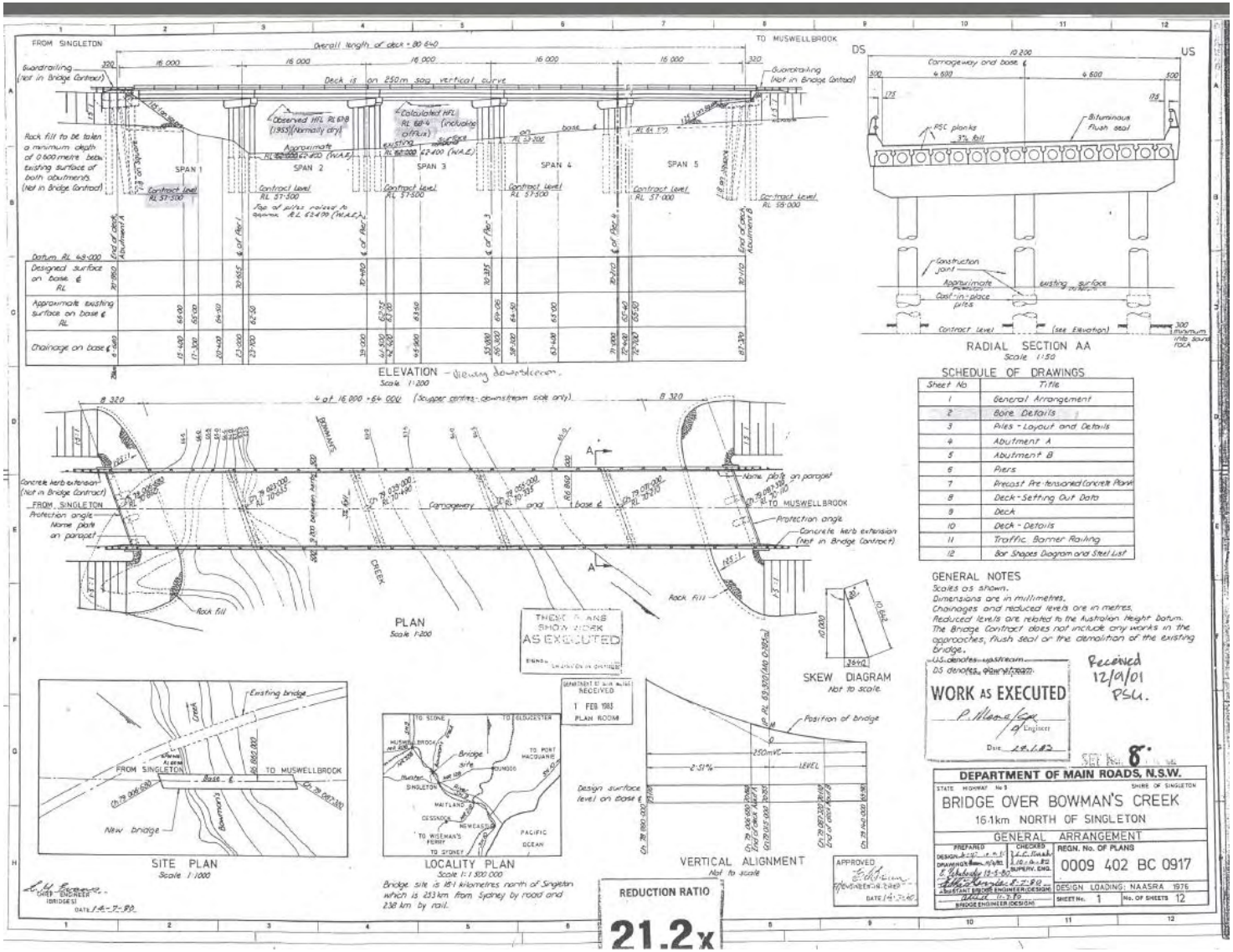
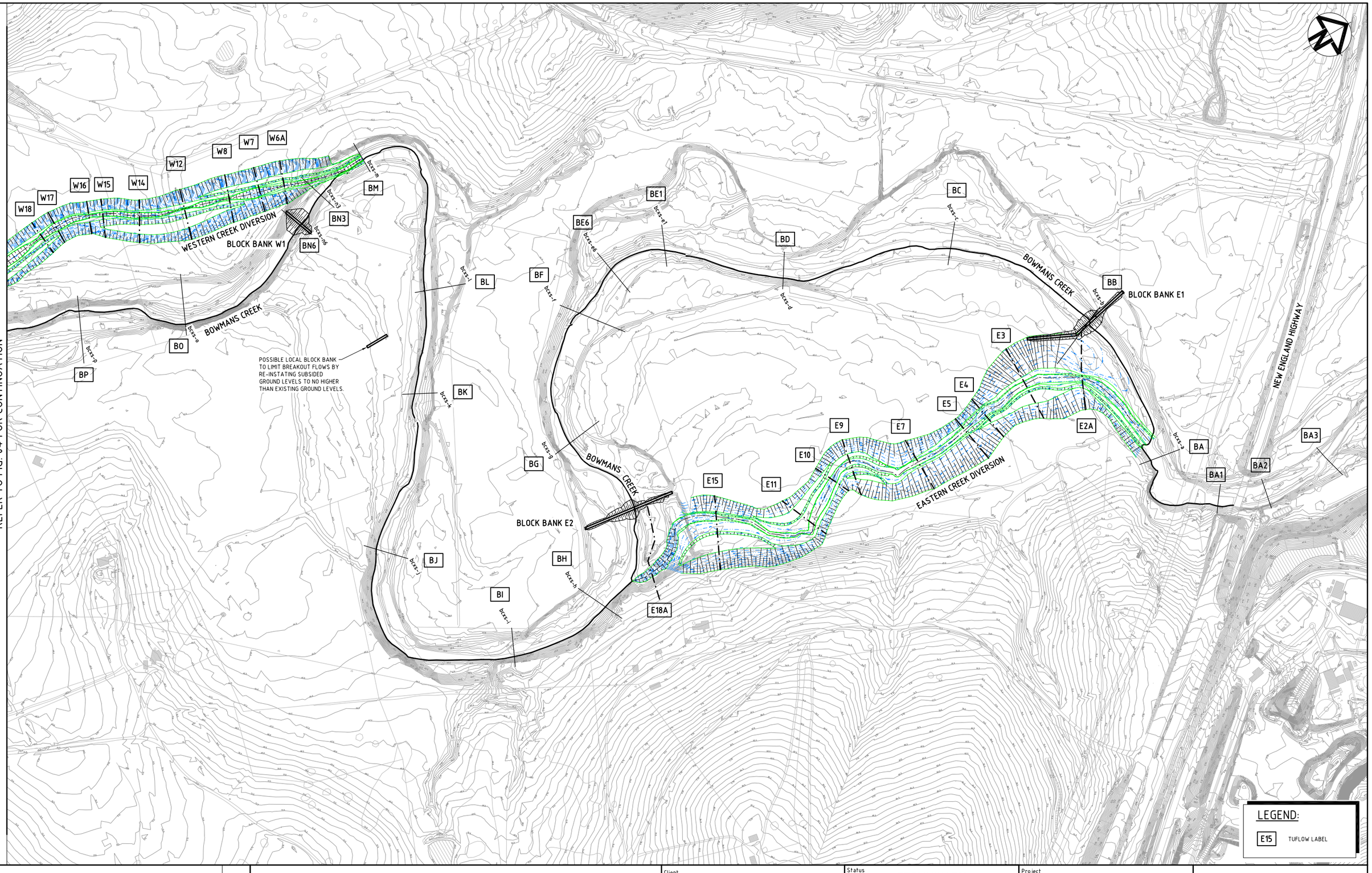


Figure B1: Bowmans Creek Bridge

REFER TO FIG. 04 FOR CONTINUATION



Issue	Description	Date
P1	PRELIMINARY FOR COMMENT	??-??-09

100mm on Original

0 50 100 150 200 250m

1 : 2500

Client: ASHTON COAL

Status: **PRELIMINARY** NOT TO BE USED FOR CONSTRUCTION

		Current Issue Signatures	
Scales	1:2500	Drawn	
Original Size	A1	Designed	
Height Datum	AHD	Checked	
Grid		Approved	

Filename: FIG_03-AA002659-NSD-00-LOCATION_PLAN_SHEET_1.dwg

Project: BOWMANS CREEK CAMBERWELL

Title: BOWMANS CREEK CHANNEL SECTION AND BLOCK BANK LOCATION PLAN - SHEET 1

HYDER CONSULTING PTY LTD
ABN 76 104 485 289
Level 5, 141 Walker St
North Sydney NSW 2060
Australia
Tel: +61 (0)2 8907 9000
Fax: +61 (0)2 8907 9001
www.hyderconsulting.com

Drawing No.	Project No.	Issue
FIG. 03	AA002659	P1

Date Plotted: 10 Sep 2009 - 10:37AM File Name: F:\AA002659\E-CAD\C-Civil\F-Figures\FIG_03-AA002659-NSD-00-LOCATION_PLAN_SHEET_1.dwg V1

REFER TO FIG. 03 FOR CONTINUATION

0 50 100 150 200 250m

1 : 2500

Issue	Description	Date
P1	PRELIMINARY FOR COMMENT	??-??-09

100mm on Original

Client: ASHTON COAL

Status: **PRELIMINARY** NOT TO BE USED FOR CONSTRUCTION

		Current Issue Signatures	
Scales	1:2500	Drawn	
Original Size	A1	Designed	
Height Datum	AHD	Checked	
Grid		Approved	

Filename: FIG_04-AA002659-NSD-00-LOCATION_PLAN_SHEET_2.dwg

Project: BOWMANS CREEK CAMBERWELL

Title: BOWMANS CREEK CHANNEL SECTION AND BLOCK BANK LOCATION PLAN - SHEET 2

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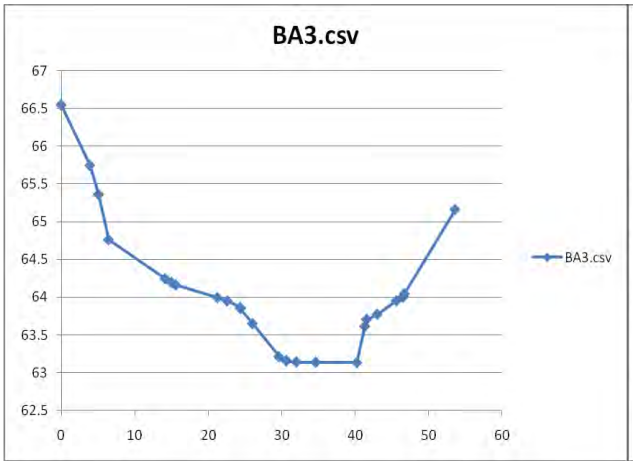
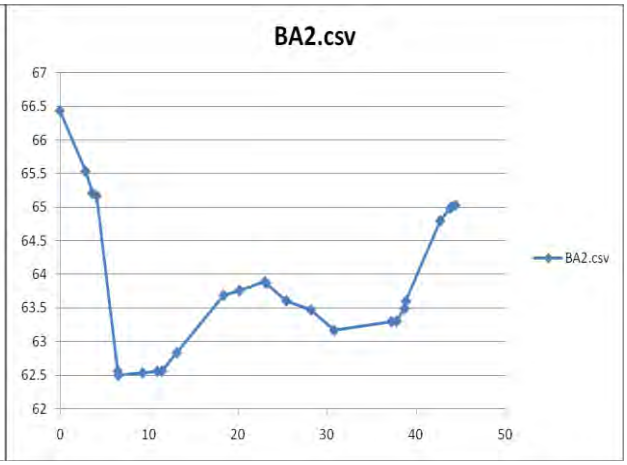
www.hyderconsulting.com

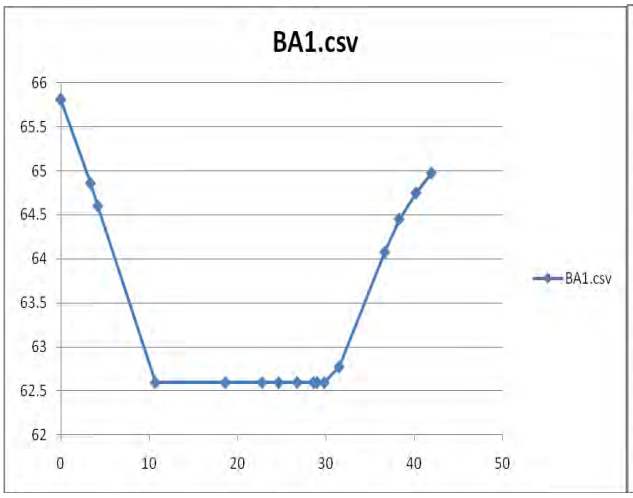
Drawing No.	Project No.	Issue
FIG. 04	AA002659	P1

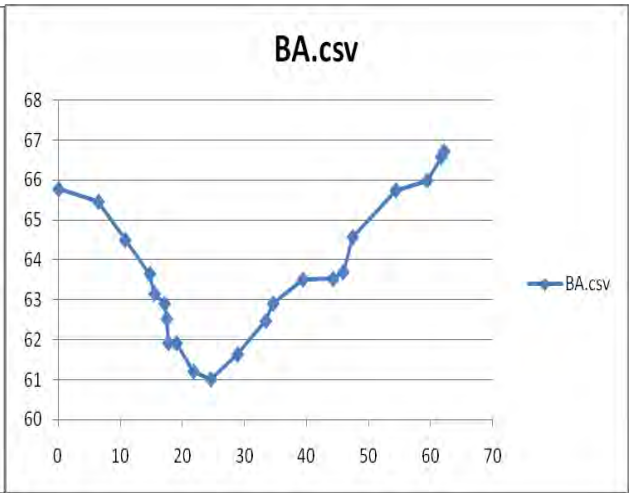
Date Plotted: 10 Sep 2009 - 10:38AM File Name: F:\AA002659\E-CAD\C-Civil\F-Figures\FIG_04-AA002659-NSD-00-LOCATION_PLAN_SHEET_2.dwg V1

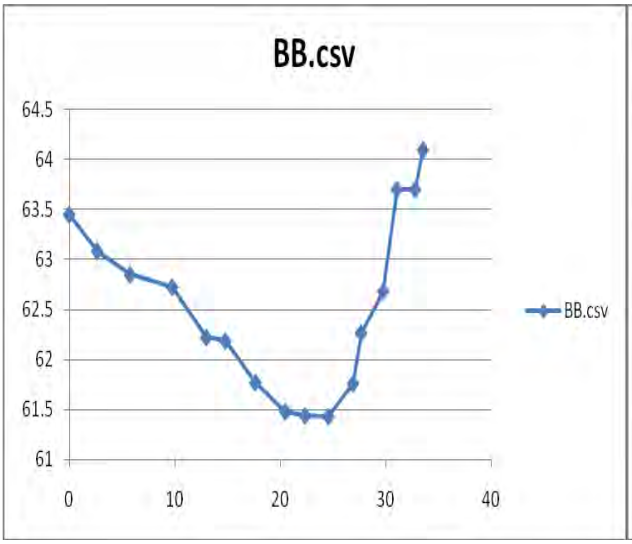
TUFLOW Channel sections (existing)

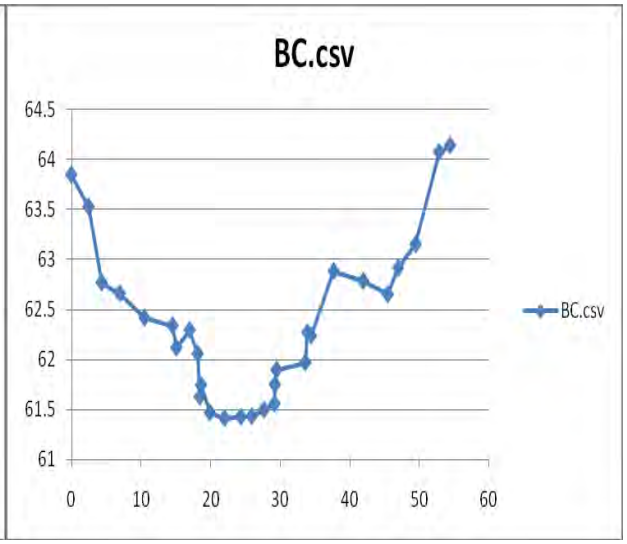


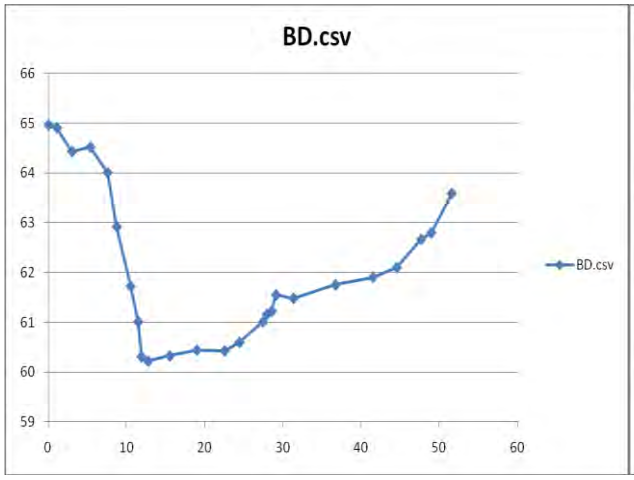








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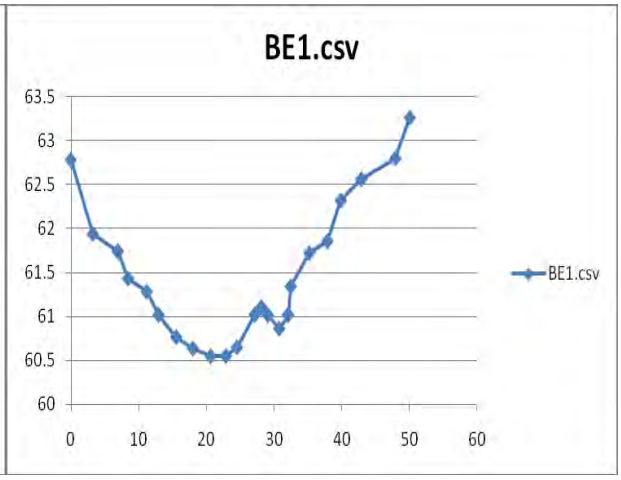
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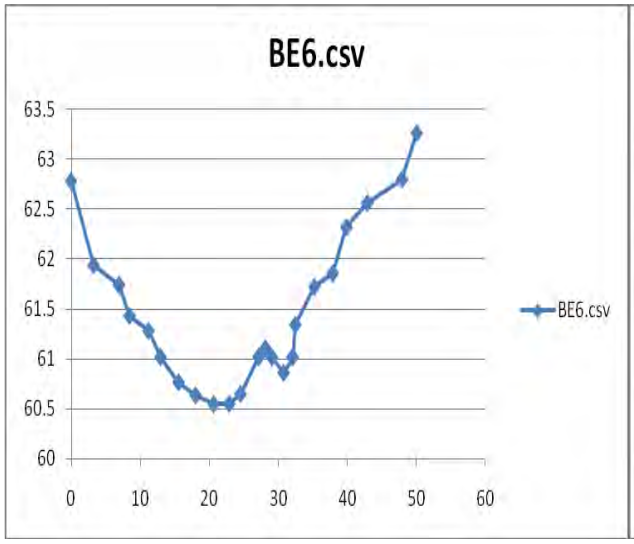
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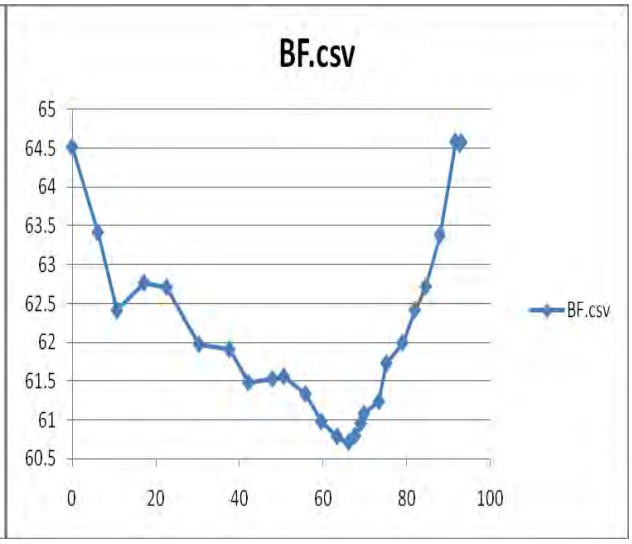
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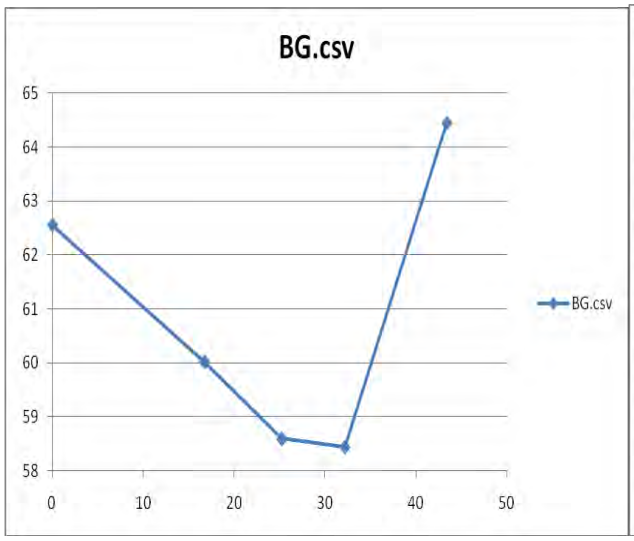
BF.csv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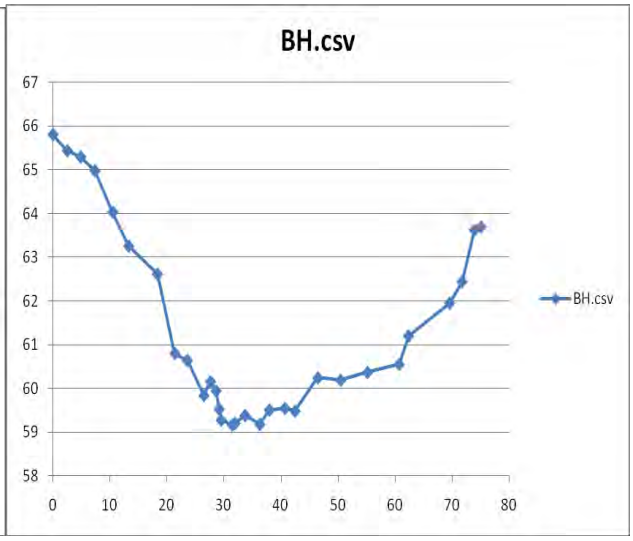
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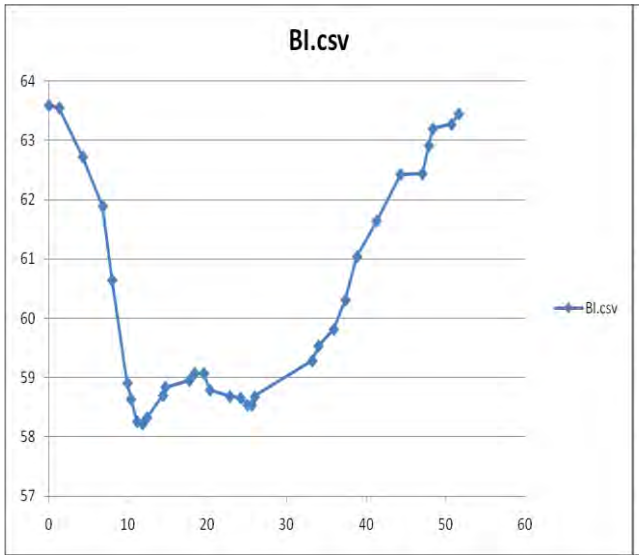
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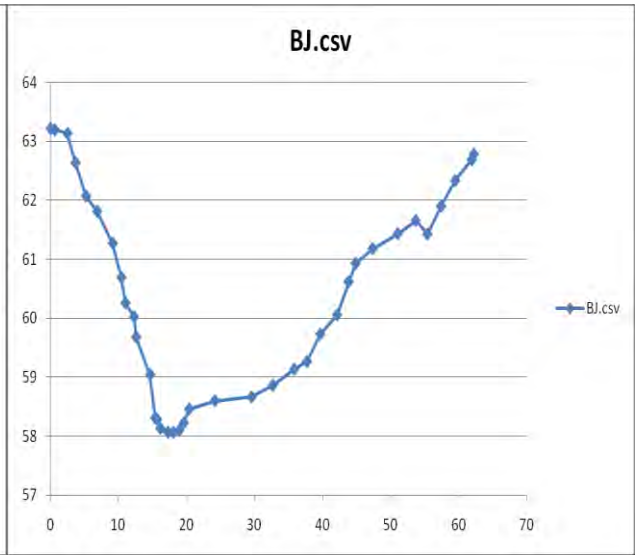
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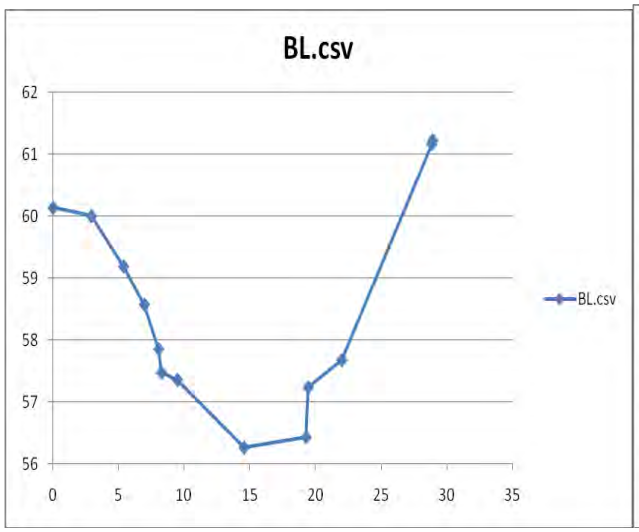
BJ.csv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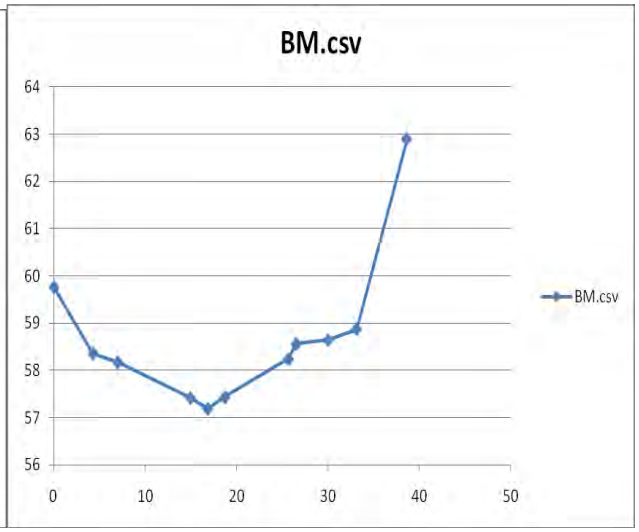
BL.csv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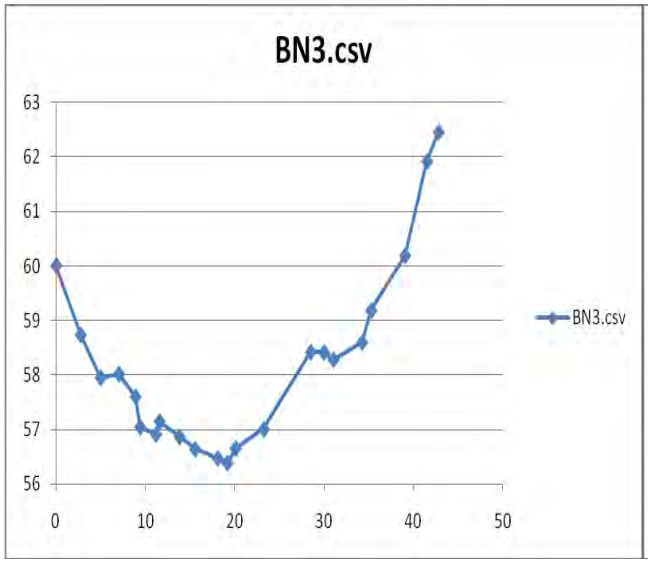
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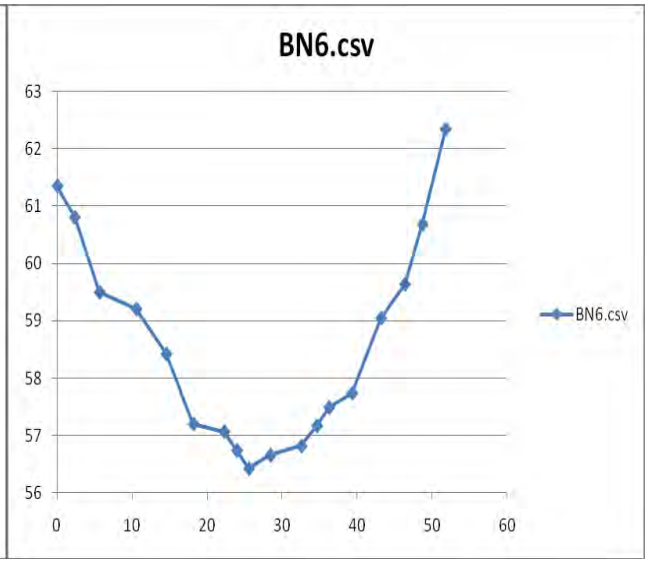
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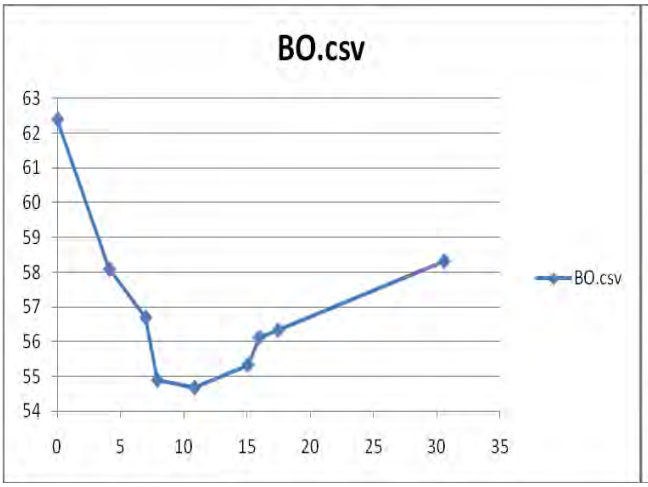
BN6.csv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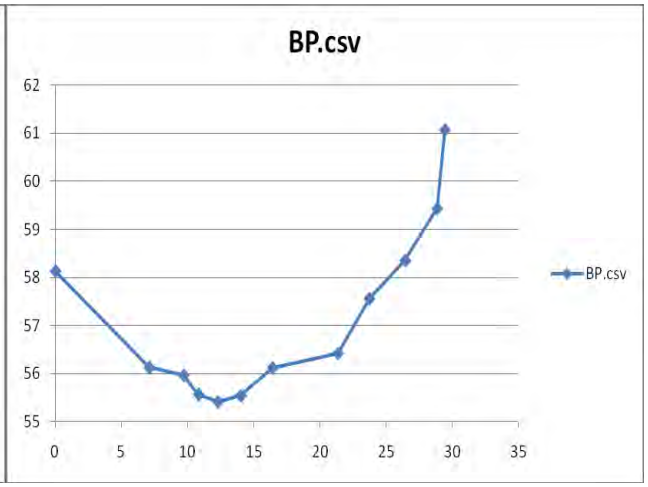
BO.csv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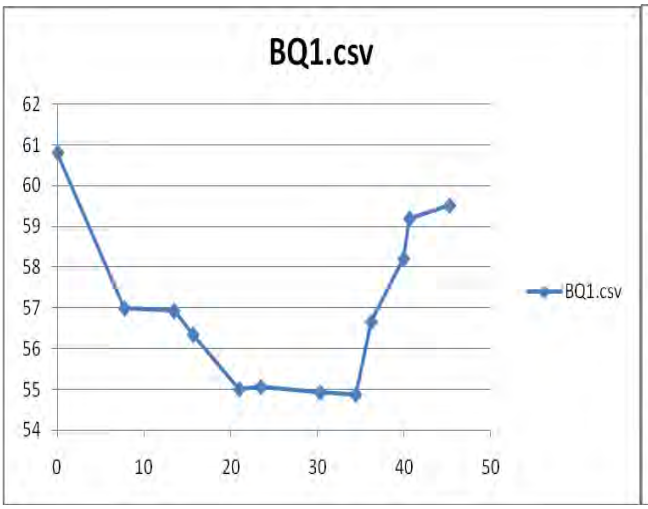
BP.csv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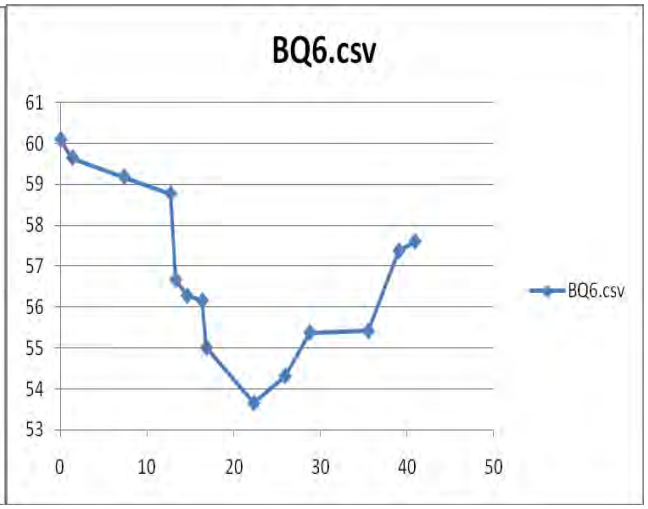
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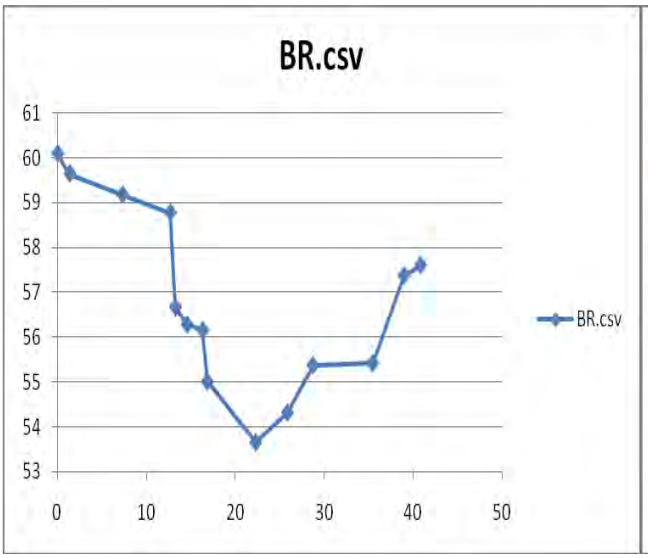
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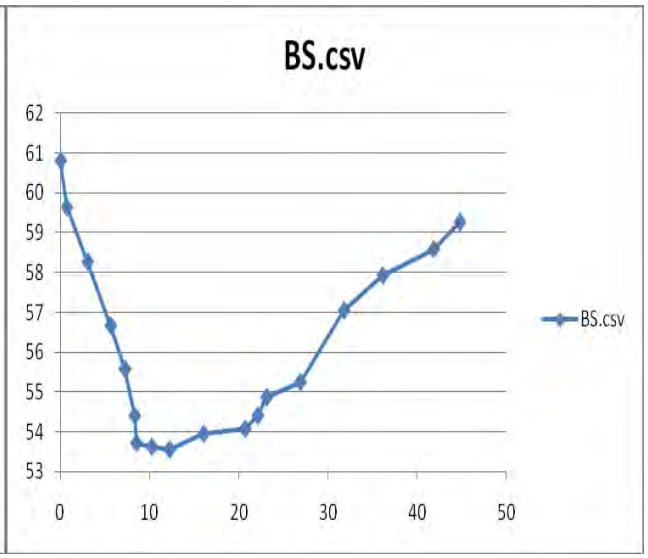
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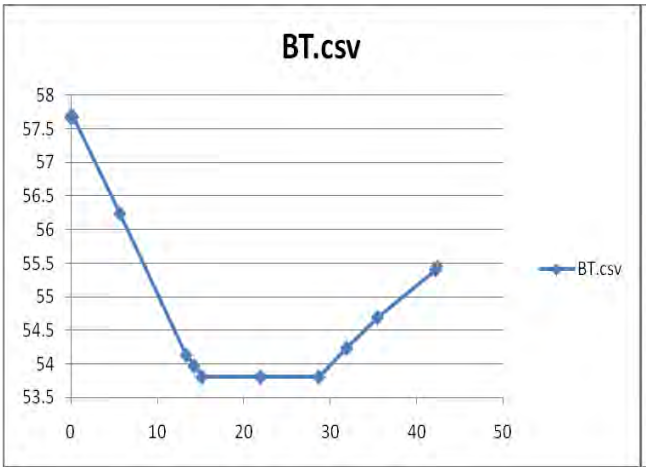
BS.csv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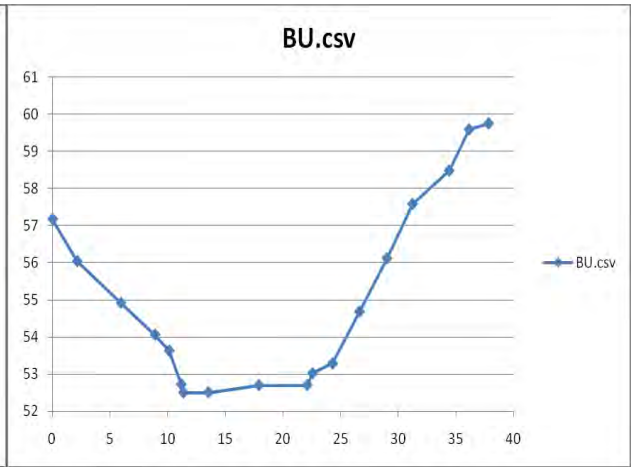
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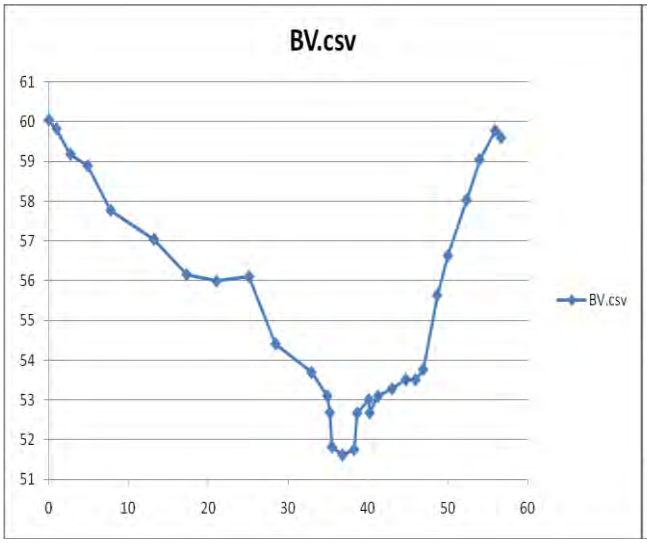
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BV.csv


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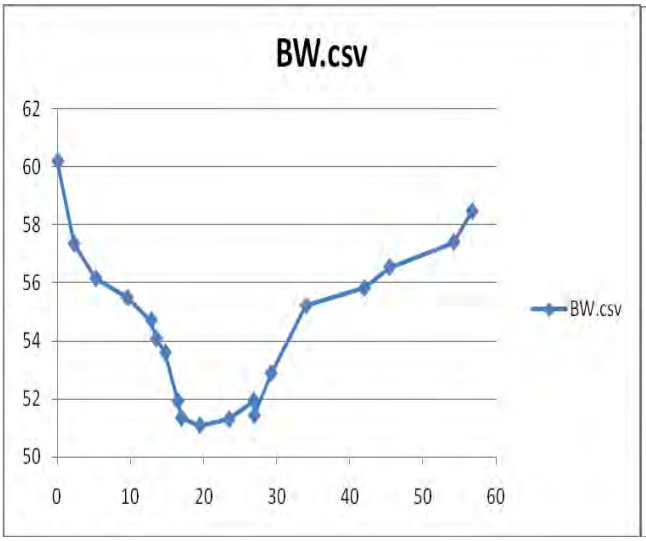
BV1.csv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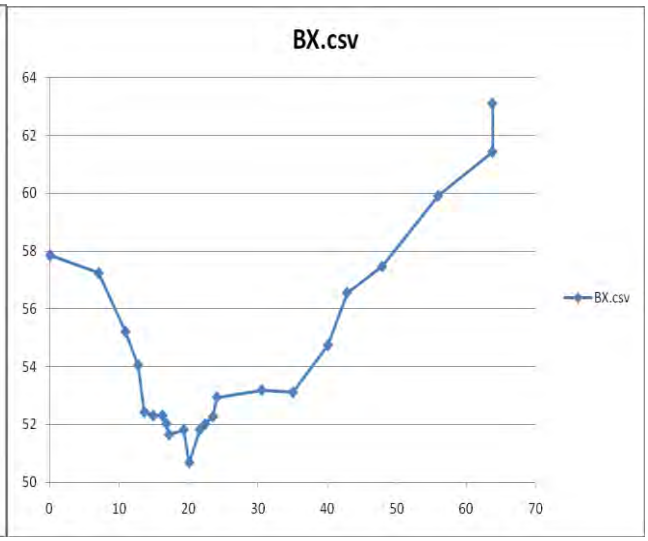
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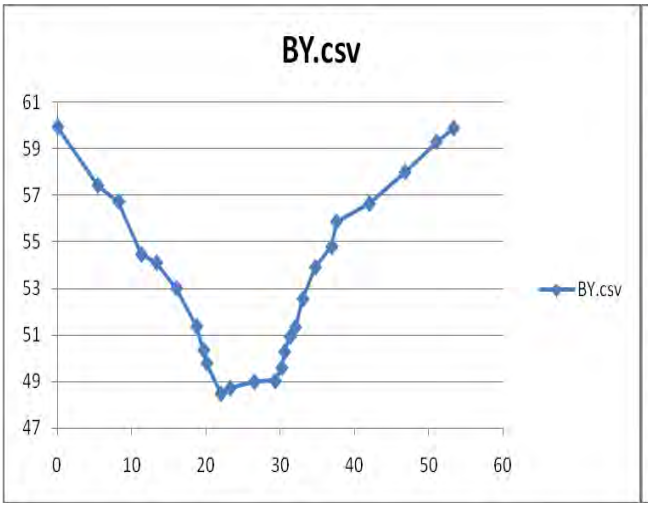
BX.csv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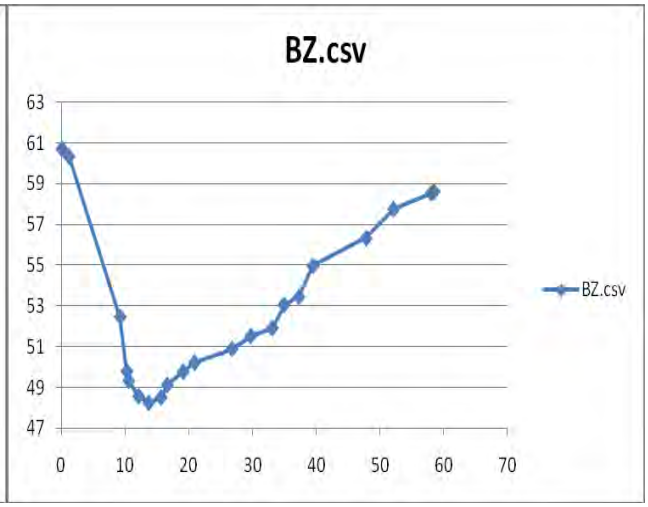
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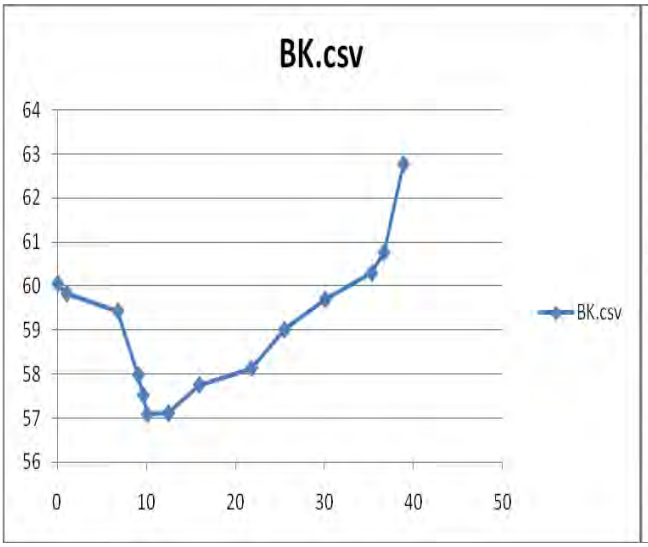
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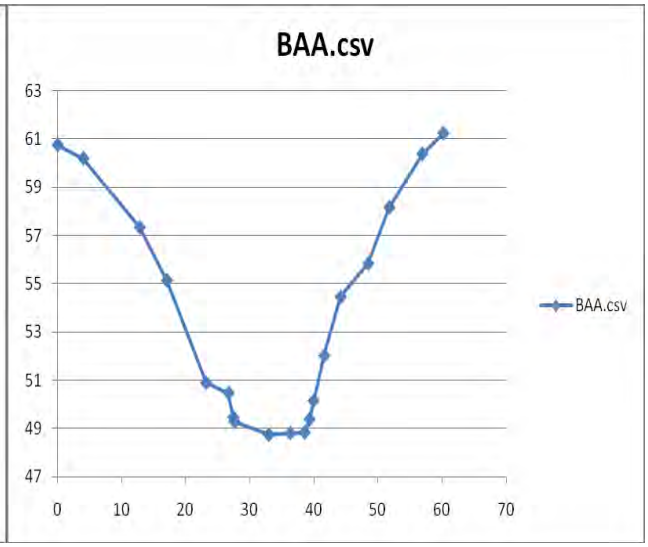
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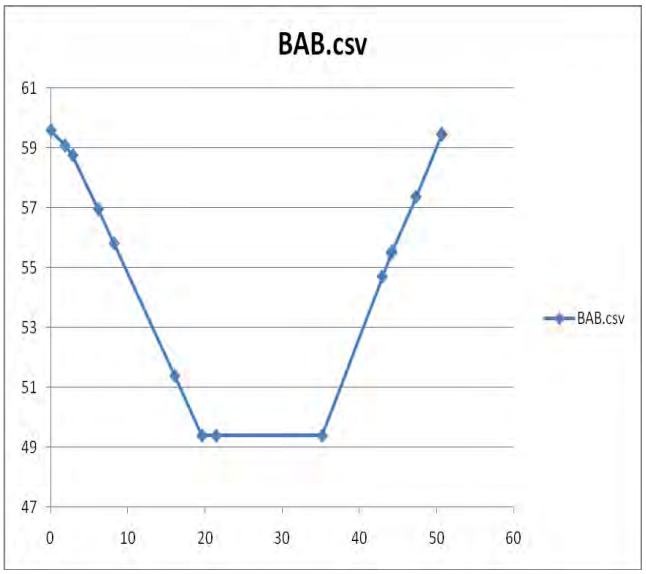
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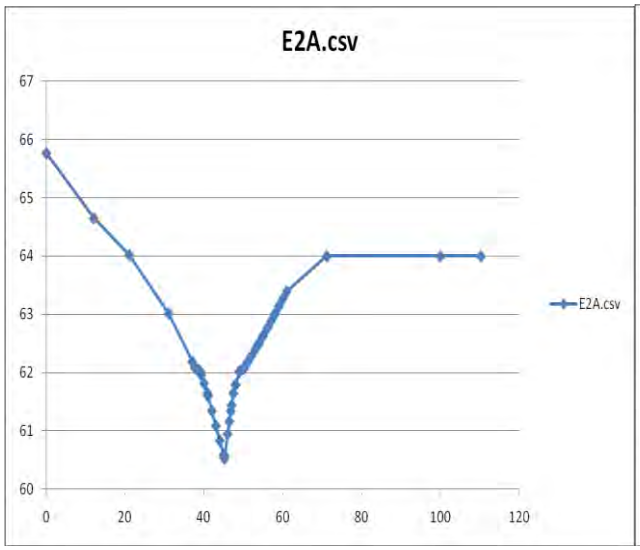
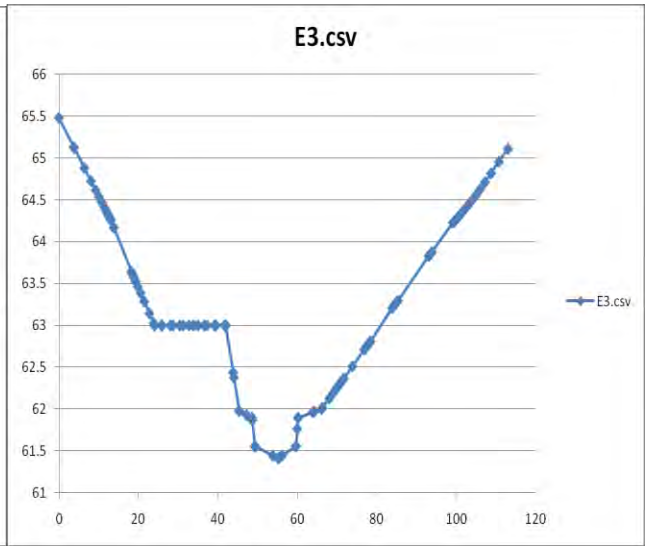
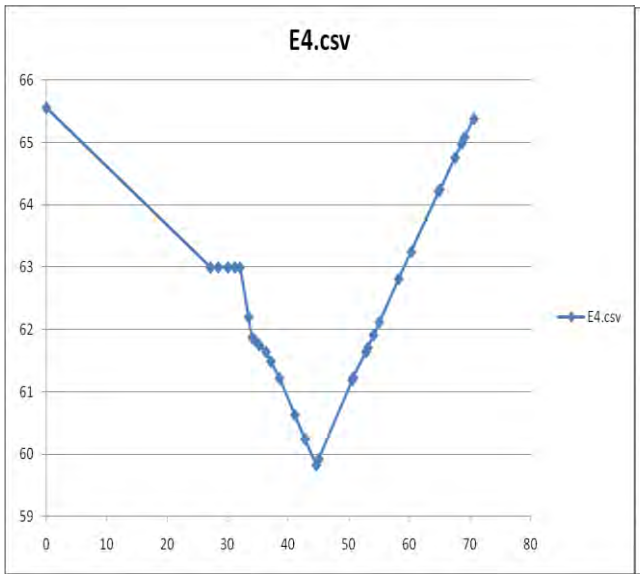
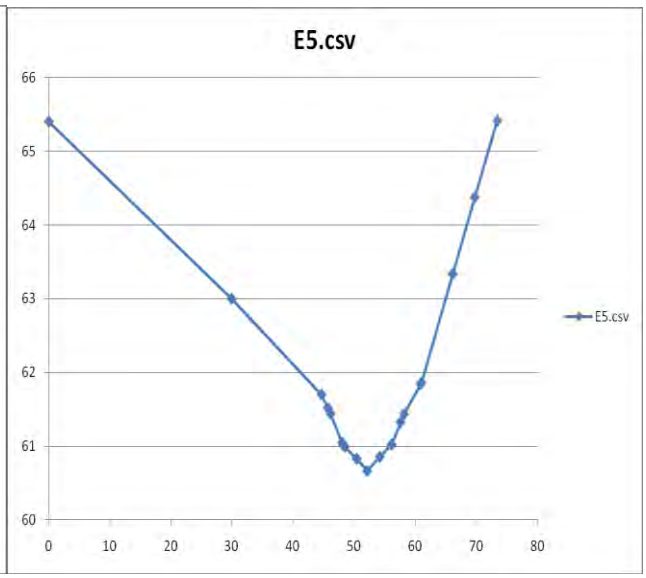
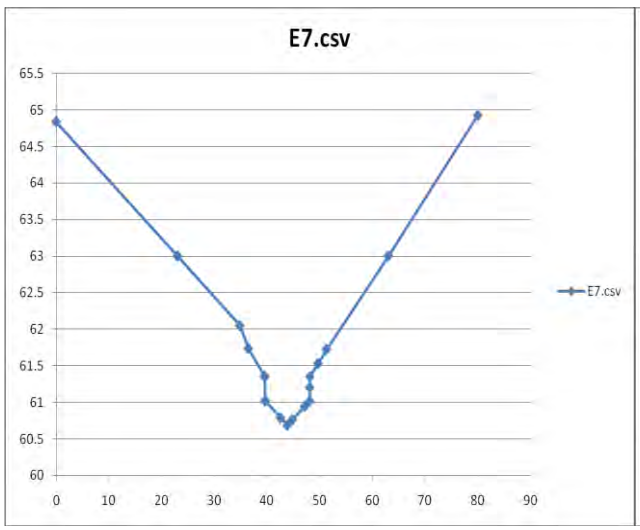
TUFLOW Channel Sections (Diversion)

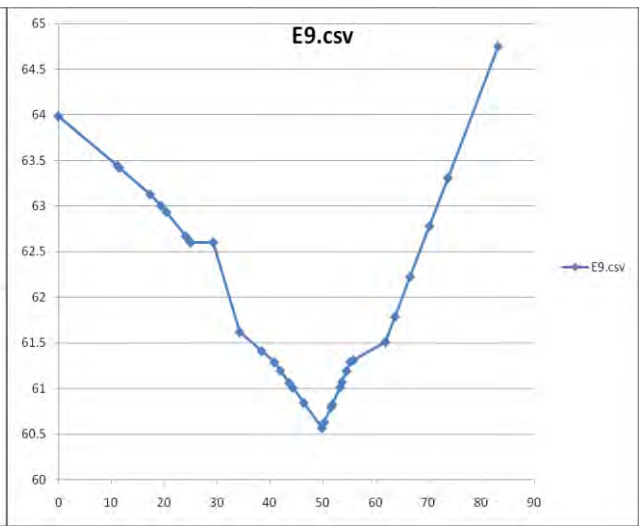


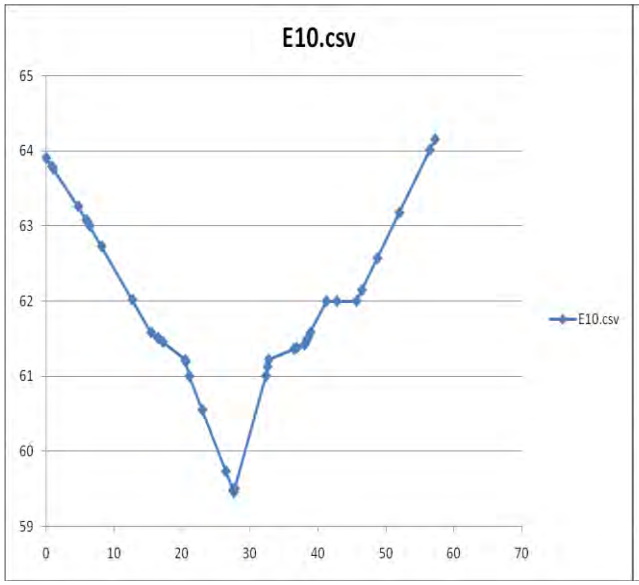








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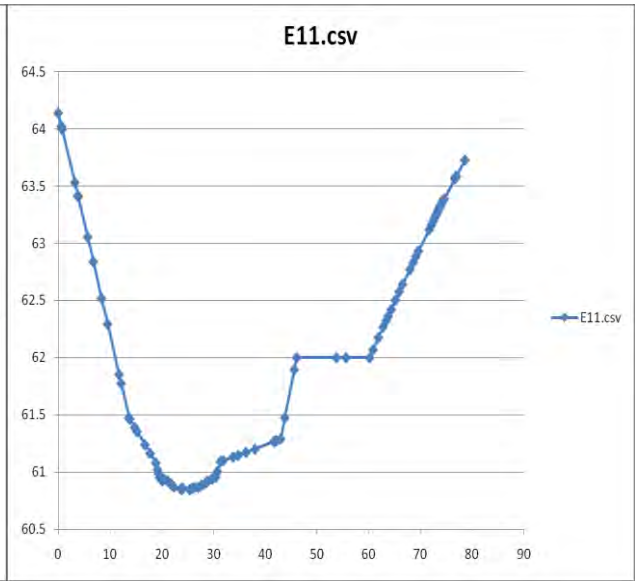
E10.csv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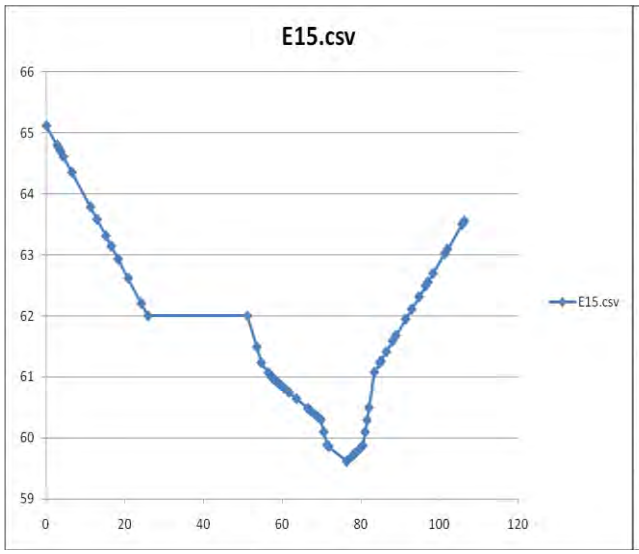
E11.csv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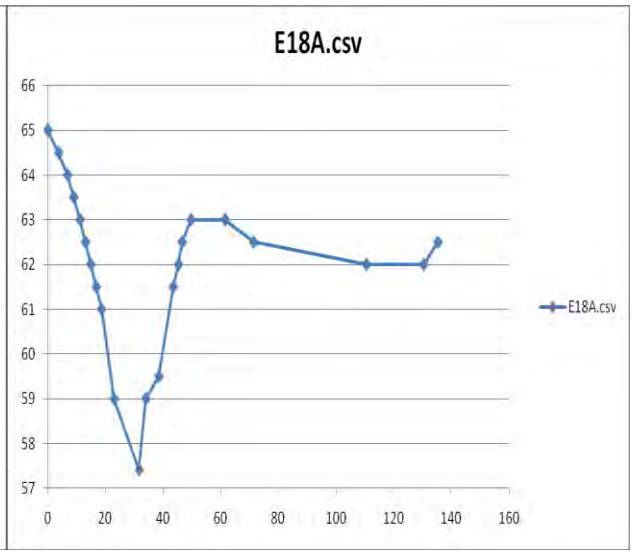
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E18A.csv


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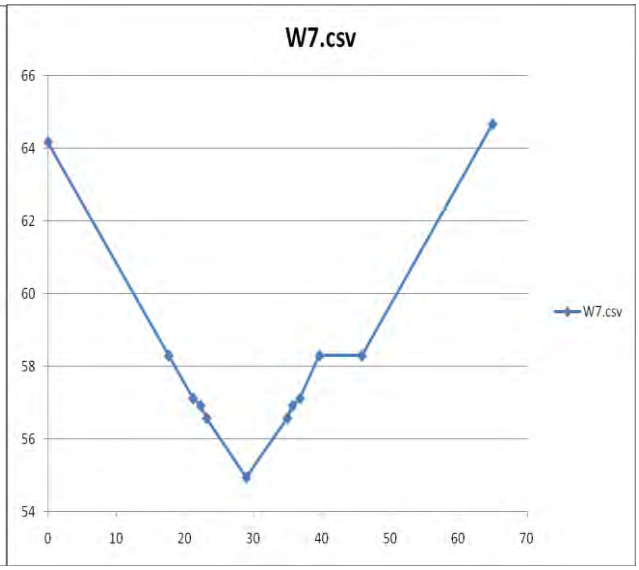
W6A.csv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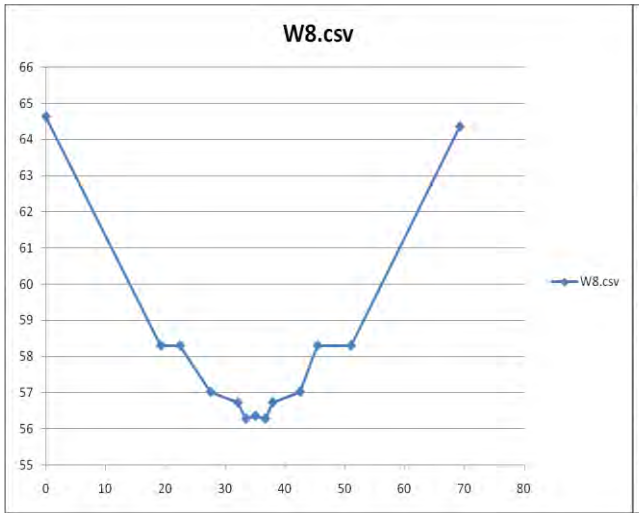
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W8.csv


W12.csv
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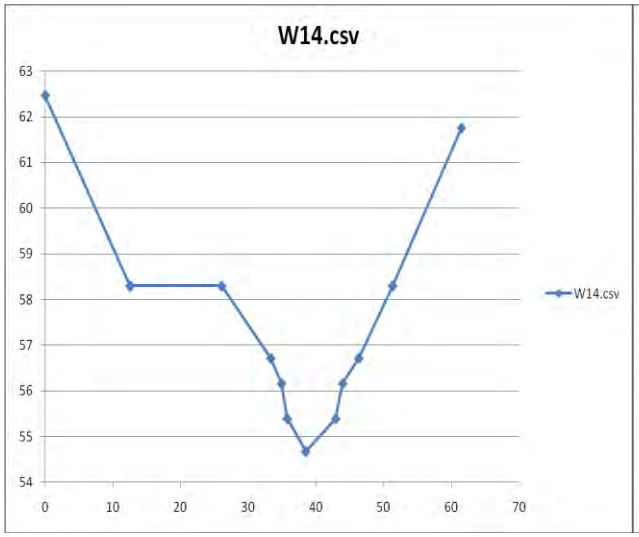
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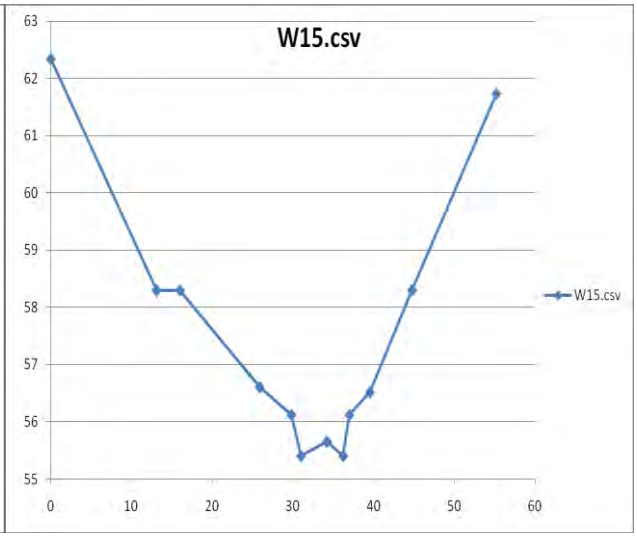
W14.csv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W15.csv


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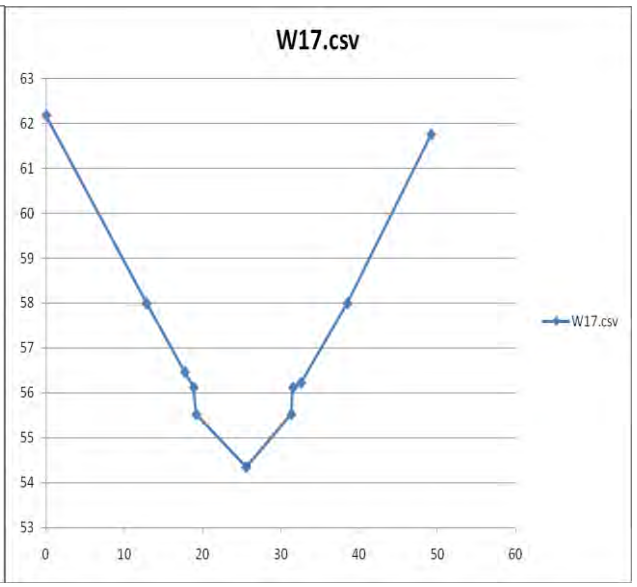
W16.csv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W17.csv


W18.csv
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W18.csv


W21.csv
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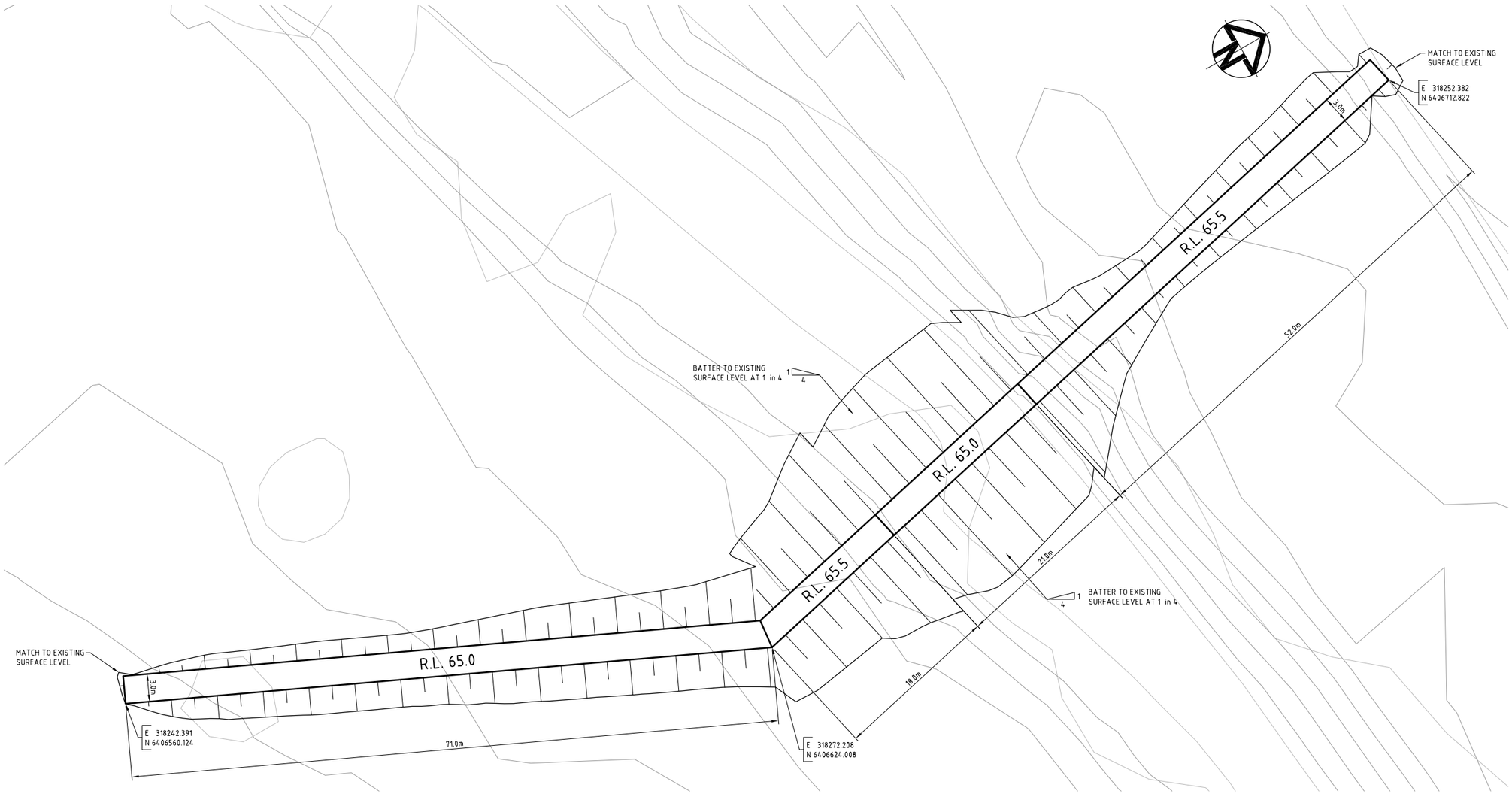
W21.csv



PLAN - BLOCK BANK E1

SCALE 1 : 250

Issue	Description	Date
P1	PRELIMINARY FOR COMMENT	??-??-09

100mm on Original

0 5 10 15 20 25m

1 : 250

Client: ASHTON COAL

Status: **PRELIMINARY**
NOT TO BE USED FOR CONSTRUCTION

Scales	AS SHOWN	Current Issue Signatures	
		Drawn	
Original Size	A1	Designed	
Height Datum	AHD	Checked	
Grid		Approved	

File Name: F:\AA002659-NSD-00-EASTERN_DIVERSION_BLOCK_BANK_E1_PLAN.dwg

Project: BOWMANS CREEK
CAMBERWELL

Title: EASTERN DIVERSION
BLOCK BANK E1 PLAN LAYOUT

HYDER CONSULTING PTY LTD
ABN 76 104 485 289
Level 5, 141 Walker St
North Sydney NSW 2060
Australia
Tel: +61 (0)2 8907 9000
Fax: +61 (0)2 8907 9001
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Drawing No.	Project No.	Issue
FIG. 05	AA002659	P1

Date Plotted: 10 Sep 2009 - 10:38AM File Name: F:\AA002659\E-CAD\C-Civil\F-Figures\FIG_05-AA002659-NSD-00-EASTERN_DIVERSION_BLOCK_BANK_E1_PLAN.dwg V1

PLAN - BLOCK BANK E2

SCALE 1 : 250

Issue	Description	Date
P1	PRELIMINARY FOR COMMENT	??-??-09

100mm on Original

0 5 10 15 20 25m

1 : 250

Client: ASHTON COAL

Status: **PRELIMINARY**
NOT TO BE USED FOR CONSTRUCTION

Scales	AS SHOWN	Current Issue Signatures	
		Drawn	
Original Size	A1	Designed	
Height Datum	AHD	Checked	
Grid		Approved	

File Name: AA002659-NSD-00-EASTERN_DIVERSION_BLOCK_BANK_E2_PLAN.dwg

Project: BOWMANS CREEK
CAMBERWELL

Title: EASTERN DIVERSION
BLOCK BANK E2 PLAN LAYOUT

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Australia

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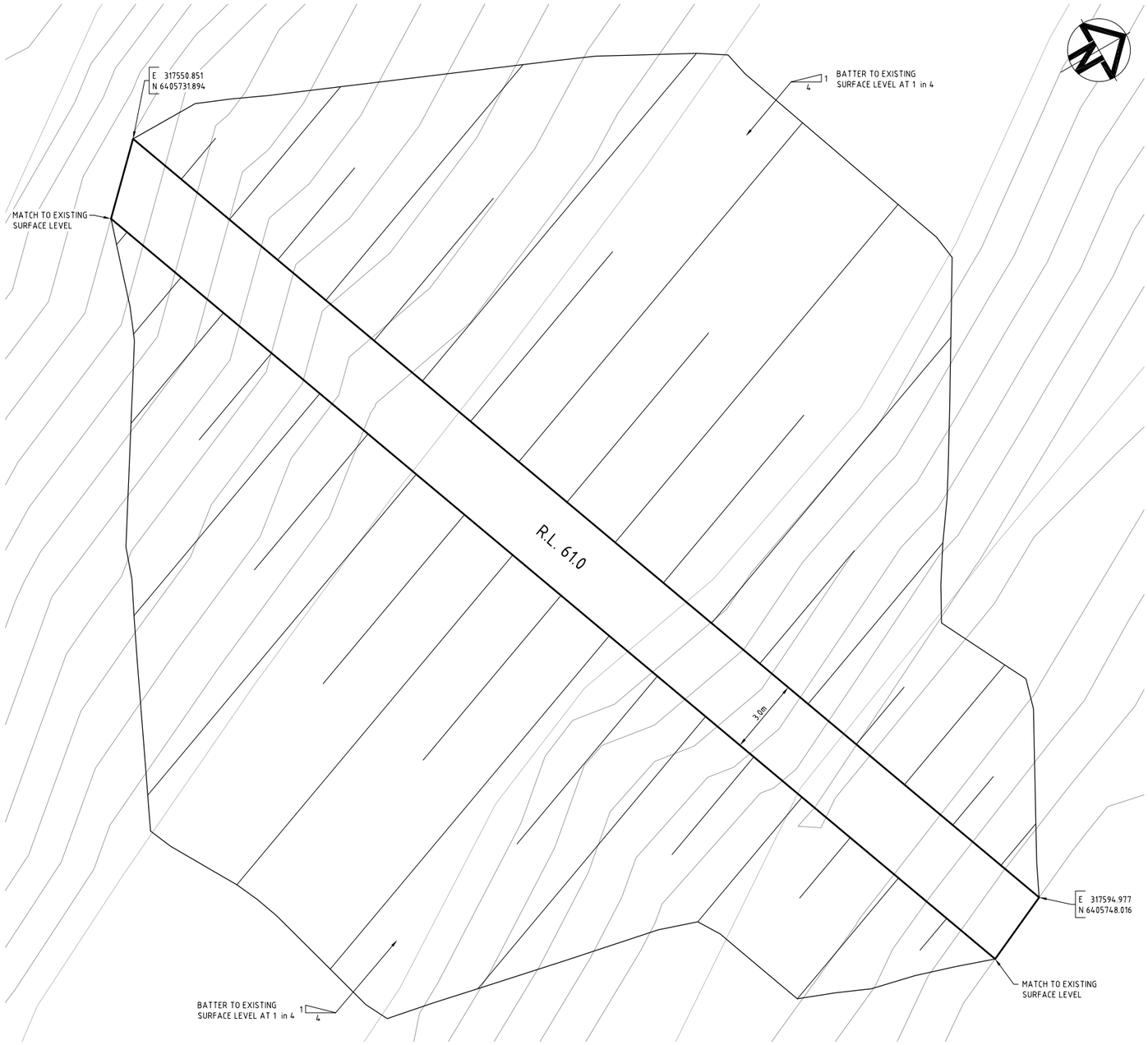
Drawing No.	Project No.	Issue
FIG. 06	AA002659	P1

Date Plotted: 10 Sep 2009 - 10:39AM File Name: F:\AA002659\E-CAD\C-Civil\F-Figures\FIG_06-AA002659-NSD-00-EASTERN_DIVERSION_BLOCK_BANK_E2_PLAN.dwg V1



PLAN - BLOCK BANK W1

SCALE 1 : 100

Issue	Description	Date
P1	PRELIMINARY FOR COMMENT	??-??-09

0 2 4 6 8 10m

1 : 100

Client: ASHTON COAL

Status: **PRELIMINARY**
NOT TO BE USED FOR CONSTRUCTION

Scales	AS SHOWN	Current Issue Signatures	
		Drawn	
Original Size	A1	Designed	
Height Datum	AHD	Checked	
Grid		Approved	

Drawing No. FIG_07-AA002659-NSD-00-WESTERN_DIVERSION_BLOCK_BANK_W1_PLAN.dwg

Project: BOWMANS CREEK
CAMBERWELL

Title: WESTERN DIVERSION
BLOCK BANK W1 PLAN LAYOUT

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ABN 76 104 485 289
Level 5, 141 Walker St
North Sydney NSW 2060
Australia
Tel: +61 (0)2 8907 9000
Fax: +61 (0)2 8907 9001
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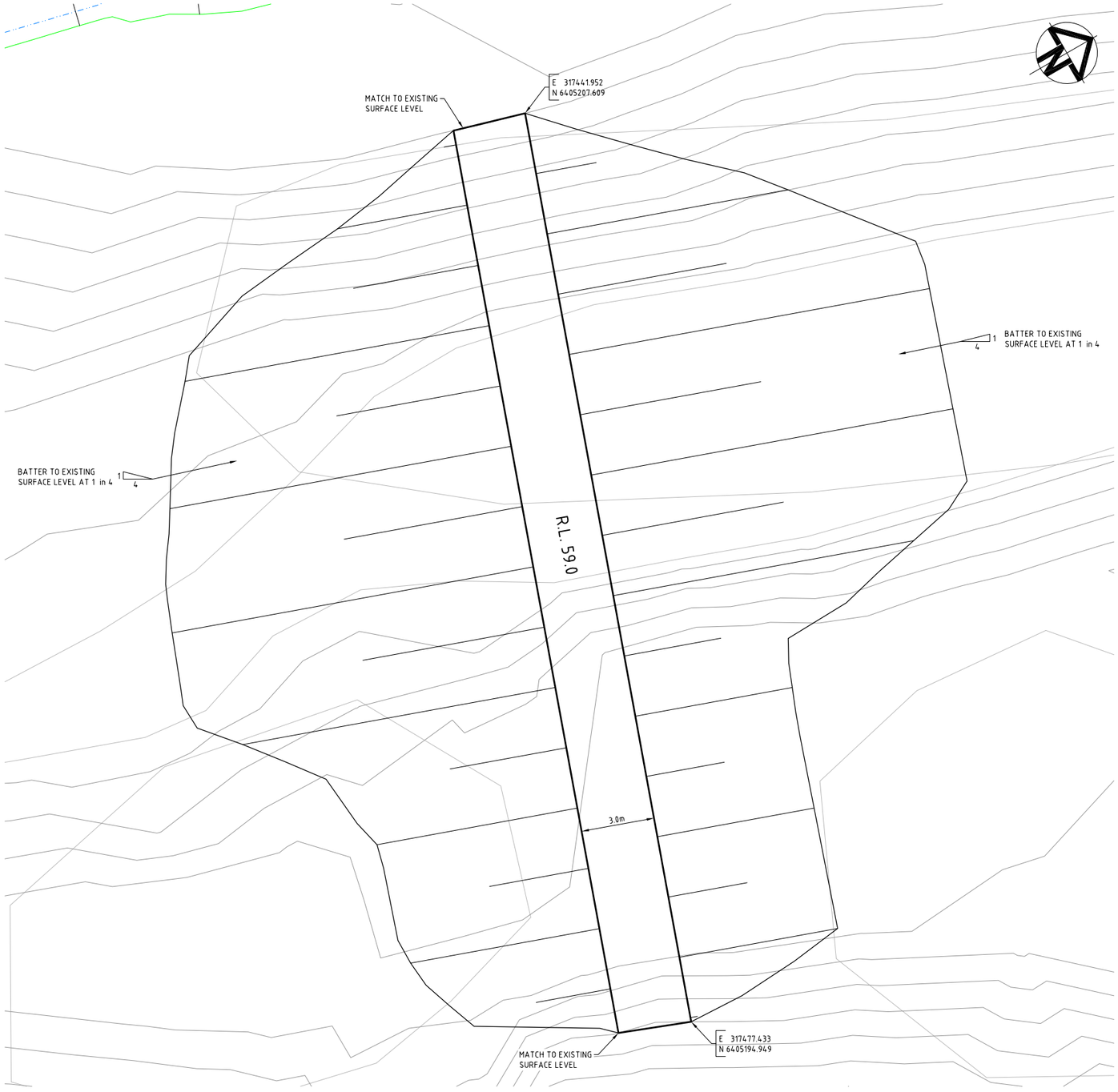
Drawing No.	Project No.	Issue
FIG. 07	AA002659	P1

100mm on Original

Date Plotted: 10 Sep 2009 - 10:39AM File Name: F:\AA002659\E-CAD\C-Civil\F-Figures\FIG_07-AA002659-NSD-00-WESTERN_DIVERSION_BLOCK_BANK_W1_PLAN.dwg V1



PLAN - BLOCK BANK W2

SCALE 1 : 100

Issue	Description	Date
P1	PRELIMINARY FOR COMMENT	??-??-09

100mm on Original

0 2 4 6 8 10m

1 : 100

Client: ASHTON COAL

Status: **PRELIMINARY**
NOT TO BE USED FOR CONSTRUCTION

Scales	AS SHOWN	Current Issue Signatures	
		Drawn	
Original Size	A1	Designed	
Height Datum	AHD	Checked	
Grid		Approved	

Project: BOWMANS CREEK CAMBERWELL

Title: WESTERN DIVERSION BLOCK BANK W2 PLAN LAYOUT

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Tel: +61 (0)2 8907 9000
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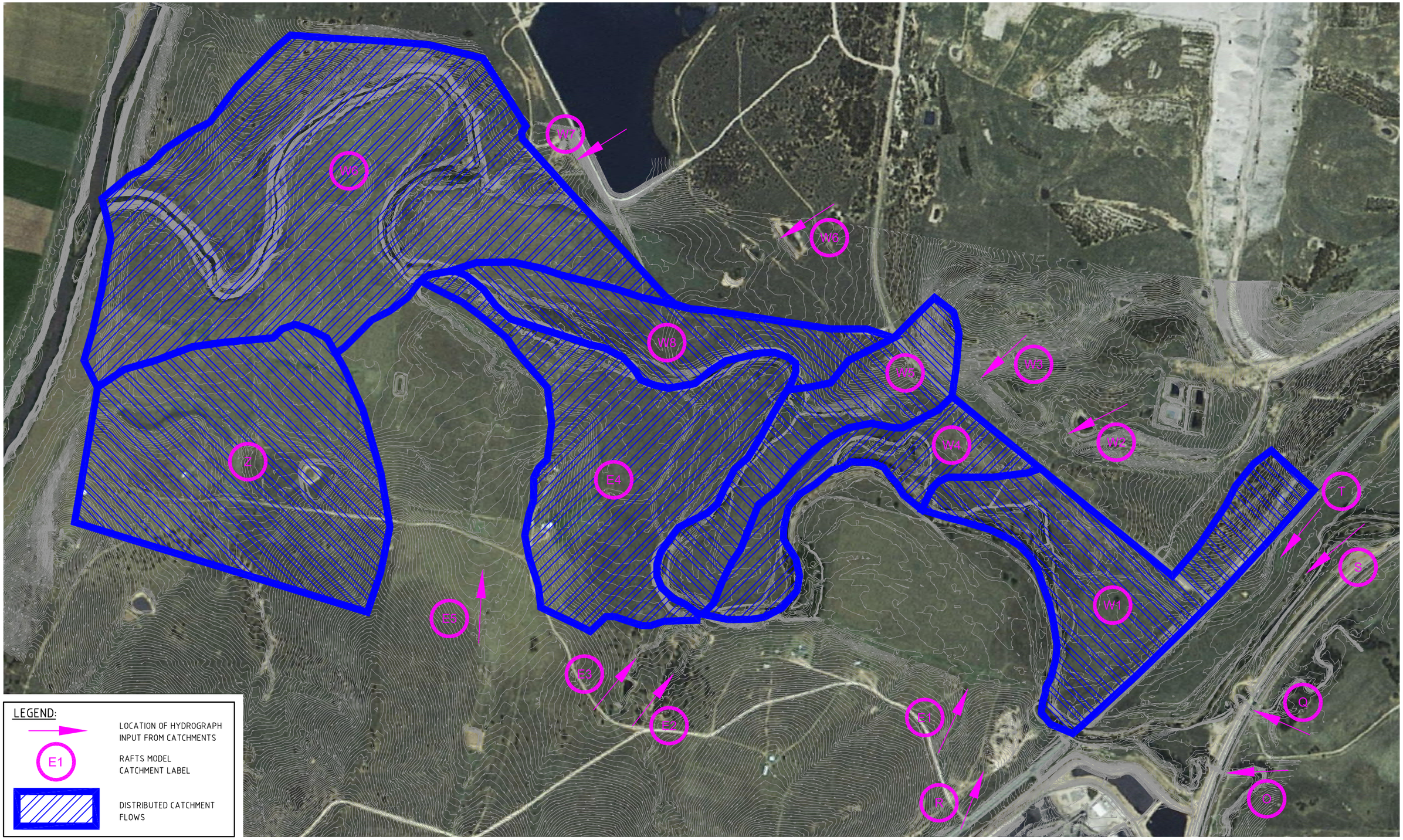
Drawing No.	Project No.	Issue
FIG. 08	AA002659	P1

File Name: F:\AA002659\E-CAD\C-Civil\F-Figures\FIG_08-AA002659-NSD-00-WESTERN_DIVERSION_BLOCK_BANK_W2_PLAN.dwg

Date Plotted: 10 Sep 2009 - 10:40AM File Name: F:\AA002659\E-CAD\C-Civil\F-Figures\FIG_08-AA002659-NSD-00-WESTERN_DIVERSION_BLOCK_BANK_W2_PLAN.dwg V1



Issue	Description	Date
P1	FINAL ISSUE	28/09/09

100mm on Original

0 100 200 300 400 500m

1 : 5000

Client: ASHTON COAL

Status

Scales	1 : 5000	Current Issue Signatures	
		Drawn	
Original Size	A1	Designed	
Height Datum	AHD	Checked	
Grid		Approved	

Filename:SKC026-AA002659-NSD-00-FLOW_INPUT_LOCATION.dwg

Project: BOWMANS CREEK CAMBERWELL

Title: TUFLOW MODEL FLOW INPUT LOCATION PLAN

HYDER CONSULTING PTY LTD
ABN 76 104 485 289
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North Sydney NSW 2060
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Fax: +61 (0)2 8907 9001
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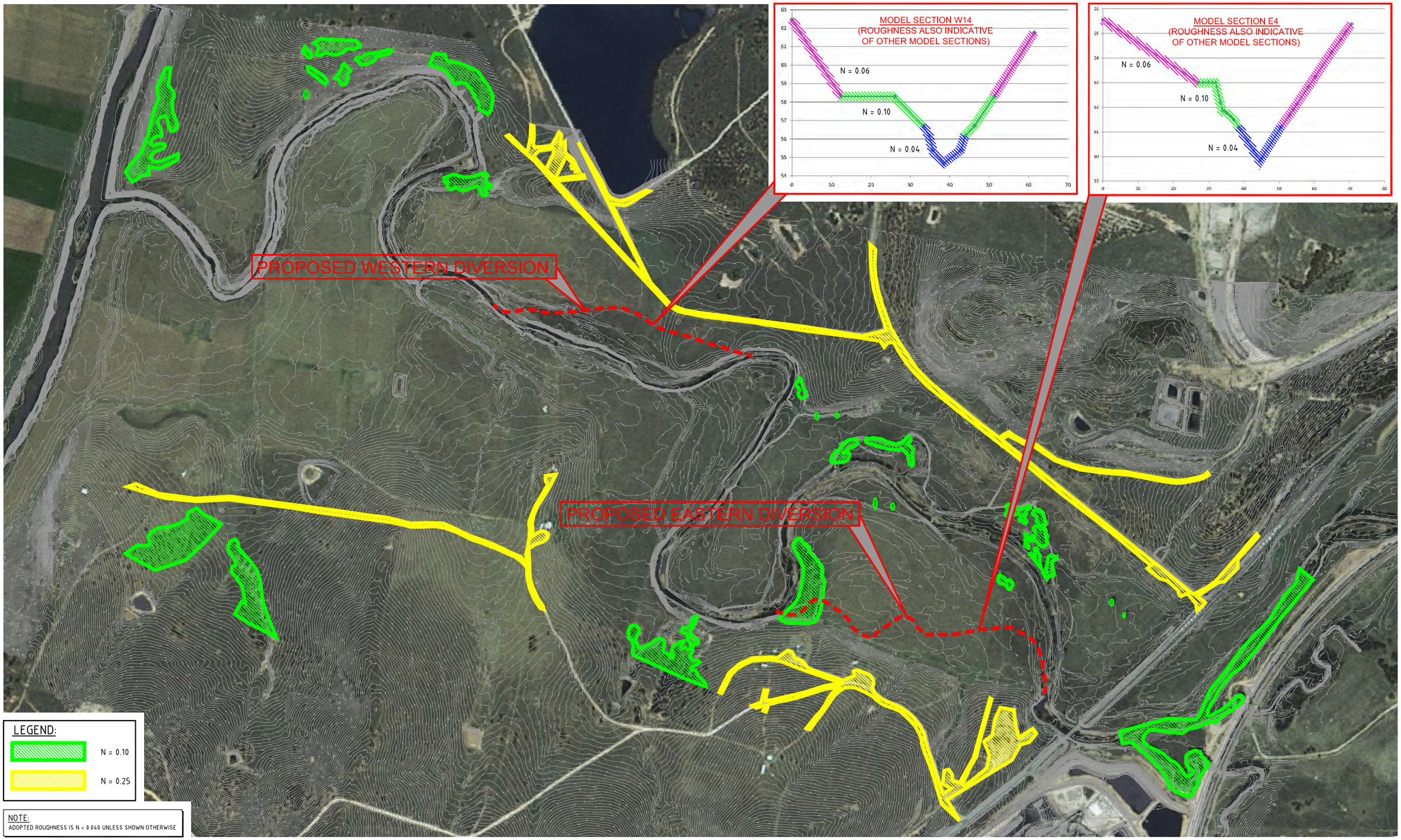
Drawing No.	Project No.	Issue
SKC026	AA002659	P1

Date Plotted: 28 Sep 2009 - 02:27PM File Name: F:\AA002659\E-CAD\C-Civil\B-Sketches\SKC026-AA002659-NSD-00-FLOW_INPUT_LOCATION.dwg V1



MODEL SECTION W14
(ROUGHNESS ALSO INDICATIVE OF OTHER MODEL SECTIONS)

MODEL SECTION E4
(ROUGHNESS ALSO INDICATIVE OF OTHER MODEL SECTIONS)

LEGEND:

N = 0.10

N = 0.25

NOTE:
ADOPTED ROUGHNESS IS N = 0.040 UNLESS SHOWN OTHERWISE

Issue	Description	Date
P1	FINAL ISSUE	28/09/09

100mm on Original

0 100 200 300 400 500m

1 : 5000

Client: ASHTON COAL

Status

Scales	1 : 5000	Current Issue Signatures	
		Drawn	
Original Size	A1	Designed	
Height Datum	AHD	Checked	
Grid		Approved	

Filename: SKC025-AA002659-NSD-00-ROUGHNESS_PLAN.dwg

Project: BOWMANS CREEK CAMBERWELL

Title: TUFLOW MODEL ROUGHNESS COEFFICIENT PLAN

HYDER CONSULTING PTY LTD
ABN 76 104 485 289
Level 5, 141 Walker St
North Sydney NSW 2060
Australia
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Fax: +61 (0)2 8907 9001
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Drawing No.	Project No.	Issue
SKC025	AA002659	P1

Date Plotted: 28 Sep 2009 - 02:28PM File Name: F:\AA002659\E-CAD\C-Civil\B-Sketches\SKC025-AA002659-NSD-00-ROUGHNESS_PLAN.dwg V1

Annexure C

TUFLOW Model Results – Existing Conditions

Bowmans Creek 1 year Existing Condition Flow Regimes with Low Hunter River Water Level

Bowmans Creek 5 year Existing Condition Flow Regimes with Low Hunter River Water Level

Bowmans Creek 20 year Existing Condition Flow Regimes with Low Hunter River Water Level

Bowmans Creek 100 year Existing Condition Flow Regimes with Low Hunter River Water Level

Bowmans Creek 1 year Existing Condition Flow Regimes with 100 year Hunter River Water Level

EXTENT OF MODELLING

NEW ENGLAND HIGHWAY

V = 1.5 m/s

V = 1.1 m/s

RESULTS UPSTREAM OF DASHED LINE SHOULD NOT BE RELIED UPON

Q = 62 m^3/s

V = 2.6 m/s

BRUNKERS LANE

V = 1.6 m/s

V = 1.3 m/s

Q = 64 m^3/s

V = 2.0 m/s

RESULTS DOWNSTREAM OF DASHED LINE SHOULD NOT BE RELIED UPON

HUNTER RIVER

EXTENT OF MODELLING

Notes

- The mapping on this drawing represents TUFLOW model results for the 1 year ARI 12 hour storm duration.
- Main channel flows and flood regimes are based on 2008 survey sections provided by Ashton Coal, with typical sections approximately 250 metres apart (refer to report information).
- Overbank floodplain areas are based on a digital terrain model provided by Ashton Coal during the process of this study.
- Local catchment flow and flood regimes away from main channel are approximate only.

Issue	Description	Date
	FINAL	28.09.09

LEGEND

Flood Depth (*m*)

0.0 - 0.1	2.0 - 2.5
0.1 - 0.2	2.5 - 3.0
0.2 - 0.4	3.0 - 3.5
0.4 - 0.6	3.5 - 4.0
0.6 - 0.8	4.0 - 4.5
0.8 - 1.0	
1.0 - 1.5	
1.5 - 2.0	

1.5 Flood Level Contours (m AHD)

V = __ m/s Representative Within Channel Velocities

0 100 200 300 400 500 m

Client: AshtonCoal

Status			
Scales	1 : 5 000	Current Issue Signatures	
		Drawn	DN
Original Size	A1	Designed	DC
Datum	GDA94	Checked	DC
Projection	MGA56	Approved	BC
Filename	G002_AA002659_03_BOWMANSCK_1YEARARI_FLOOD_090826.MXD		

Project: BOWMANS CREEK

Title: 1 YEAR ARI FLOOD DEPTH AND FLOOD CONTOURS FOR EXISTING CONDITIONS ASSUMING LOW HUNTER RIVER LEVEL

HYDER CONSULTING PTY LTD
ABN 76 104 485 289
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North Sydney NSW 2060
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Fax: +61 (0) 2 8907 9001
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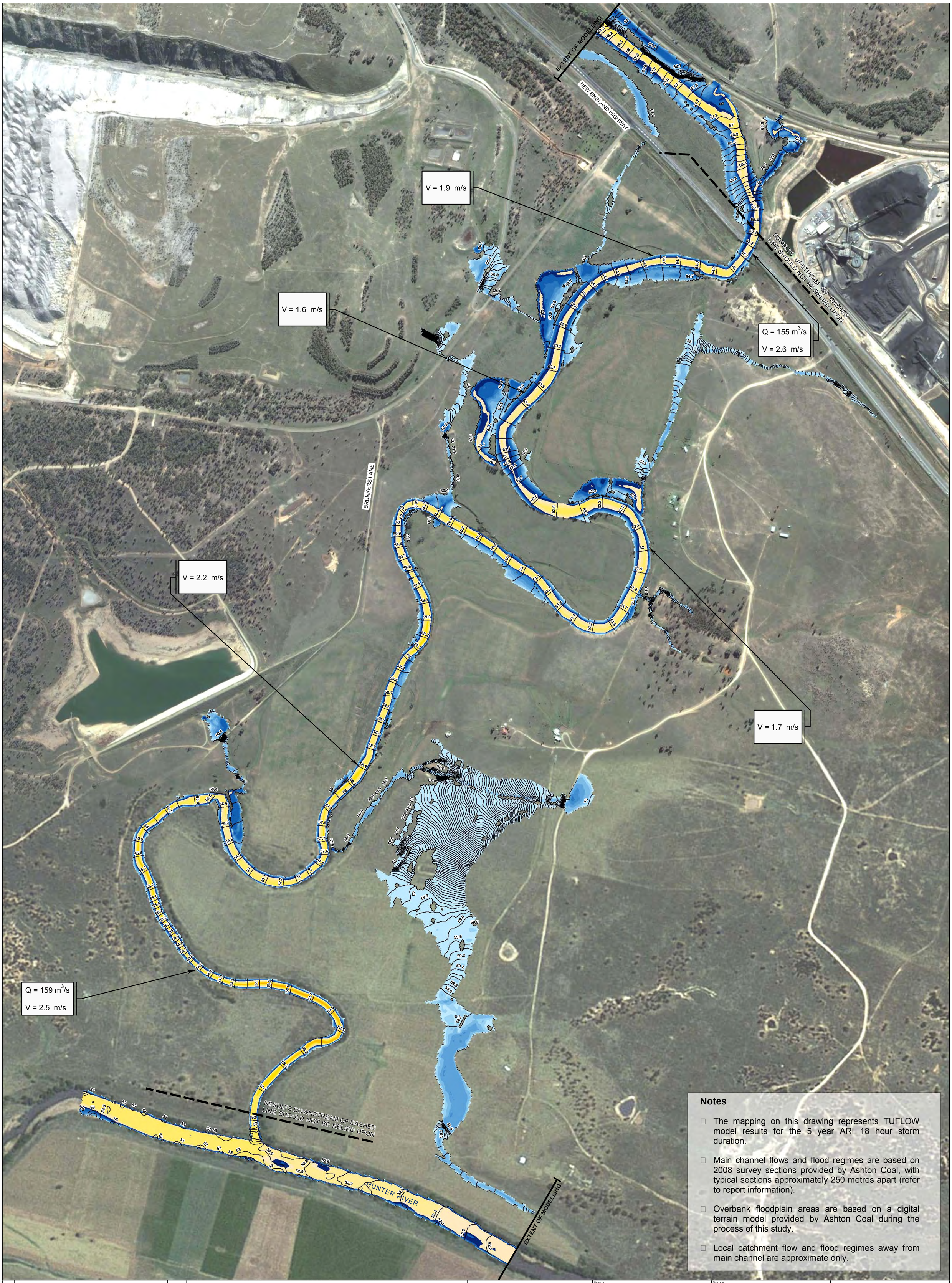
Drawing No.	Project No.	Issue
G002	AA002659	03



Notes

- The mapping on this drawing represents TUFLOW model results for the 5 year ARI 18 hour storm duration.
- Main channel flows and flood regimes are based on 2008 survey sections provided by Ashton Coal, with typical sections approximately 250 metres apart (refer to report information).
- Overbank floodplain areas are based on a digital terrain model provided by Ashton Coal during the process of this study.
- Local catchment flow and flood regimes away from main channel are approximate only.

Issue	Description	Date
	FINAL	28.09.09

LEGEND

Flood Depth (*m*)

0.0 - 0.1	2.0 - 2.5
0.1 - 0.2	2.5 - 3.0
0.2 - 0.4	3.0 - 3.5
0.4 - 0.6	3.5 - 4.0
0.6 - 0.8	4.0 - 4.5
0.8 - 1.0	4.5 - 5.0
1.0 - 1.5	5.0 - 5.5
1.5 - 2.0	

1.5 Flood Level Contours (m AHD)

V = __ m/s Representative Within Channel Velocities

0 100 200 300 400 500 m

Client: AshtonCoal

Status			
Scales	1 : 5 000	Current Issue Signatures	
		Drawn	DN
Original Size	A1	Designed	DC
Datum	GDA94	Checked	DC
Projection	MGA56	Approved	BC
Filename	G004_AA002659_03_BOWMANSCK_5YEARARI_FLOOD_090827.MXD		

Project: BOWMANS CREEK

Title: 5 YEAR ARI FLOOD DEPTH AND FLOOD CONTOURS FOR EXISTING CONDITIONS ASSUMING LOW HUNTER RIVER LEVEL

HYDER CONSULTING PTY LTD
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Drawing No.	Project No.	Issue
G004	AA002659	03

EXTENT OF MODELLING

NEW ENGLAND HIGHWAY

V = 2.4 m/s

V = 2.0 m/s

V = 2.8 m/s

Q = 318 m^3/s
V = 2.8 m/s

RESULTS UPSTREAM OF DASHED LINE SHOULD NOT BE RELIED UPON

BRUNKERS LANE

V = 2.2 m/s

Q = 328 m^3/s
V = 3.1 m/s

RESULTS DOWNSTREAM OF DASHED LINE SHOULD NOT BE RELIED UPON

HUNTER RIVER

EXTENT OF MODELLING

Notes

- The mapping on this drawing represents TUFLOW model results for the 20 year ARI 18 hour storm duration.
- Main channel flows and flood regimes are based on 2008 survey sections provided by Ashton Coal, with typical sections approximately 250 metres apart (refer to report information).
- Overbank floodplain areas are based on a digital terrain model provided by Ashton Coal during the process of this study.
- Local catchment flow and flood regimes away from main channel are approximate only.

Issue	Description	Date
	FINAL	28.09.09

LEGEND

Flood Depth (*m*)

0.0 - 0.1	2.0 - 2.5	6.0 - 6.5
0.1 - 0.2	2.5 - 3.0	6.5 - 7.0
0.2 - 0.4	3.0 - 3.5	
0.4 - 0.6	3.5 - 4.0	
0.6 - 0.8	4.0 - 4.5	
0.8 - 1.0	4.5 - 5.0	
1.0 - 1.5	5.0 - 5.5	
1.5 - 2.0	5.5 - 6.0	

1.5 Flood Level Contours (m AHD)

V = __ m/s Representative Within Channel Velocities

0 100 200 300 400 500 m

Client: AshtonCoal

Status	
Scales	1 : 5 000
Original Size	A1
Datum	GDA94
Projection	MGA56
Filename	G003_AA002659_03_BOWMANSCK_20YEARARI_FLOOD_090827.MXD

Current Issue Signatures

Drawn	DN
Designed	DC
Checked	DC
Approved	BC

Project: BOWMANS CREEK

Title: 20 YEAR ARI FLOOD DEPTH AND FLOOD CONTOURS FOR EXISTING CONDITIONS ASSUMING LOW HUNTER RIVER LEVEL

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Australia
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Fax: +61 (0) 2 8907 9001
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Drawing No.	Project No.	Issue
G003	AA002659	03

EXTENT OF MODELLING

NEW ENGLAND HIGHWAY

V = 2.7 m/s

V = 2.6 m/s

RESULTS UPSTREAM OF DASHED LINE SHOULD NOT BE RELIED UPON

Q = 700 m^3/s

V = 4.3 m/s

BRUNKERS LANE

V = 3.5 m/s

V = 2.7 m/s

Q = 736 m^3/s

V = 3.8 m/s

RESULTS DOWNSTREAM OF DASHED LINE SHOULD NOT BE RELIED UPON

HUNTER RIVER

EXTENT OF MODELLING

Notes

- The mapping on this drawing represents TUFLOW model results for the 100 year ARI 12 hour storm duration.
- Main channel flows and flood regimes are based on 2008 survey sections provided by Ashton Coal, with typical sections approximately 250 metres apart (refer to report information).
- Overbank floodplain areas are based on a digital terrain model provided by Ashton Coal during the process of this study.
- Local catchment flow and flood regimes away from main channel are approximate only.

Issue	Description	Date
	FINAL	28.09.09

LEGEND

Flood Depth (*m*)

0.0 - 0.1	2.0 - 2.5	6.0 - 6.5
0.1 - 0.2	2.5 - 3.0	6.5 - 7.0
0.2 - 0.4	3.0 - 3.5	7.0 - 7.5
0.4 - 0.6	3.5 - 4.0	7.5 - 8.0
0.6 - 0.8	4.0 - 4.5	8.0 - 8.5
0.8 - 1.0	4.5 - 5.0	8.5 - 9.0
1.0 - 1.5	5.0 - 5.5	9.0 - 9.5
1.5 - 2.0	5.5 - 6.0	

1.5 Flood Level Contours (m AHD)

V = __ m/s Representative Within Channel Velocities

0 100 200 300 400 500 m

Client: AshtonCoal

Status	
Scales	1 : 5 000
Original Size	A1
Datum	GDA94
Projection	MGA56
Filename	G001_AA002659_03_BOWMANSCK_100YEARARI_FLOOD_090826.MXD

Current Issue Signatures: Drawn DN; Designed DC; Checked DC; Approved BC

Project: BOWMANS CREEK

Title: 100 YEAR ARI FLOOD DEPTH AND FLOOD CONTOURS FOR EXISTING CONDITIONS ASSUMING LOW HUNTER RIVER LEVEL

HYDER CONSULTING PTY LTD
ABN 76 104 485 289
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North Sydney NSW 2060
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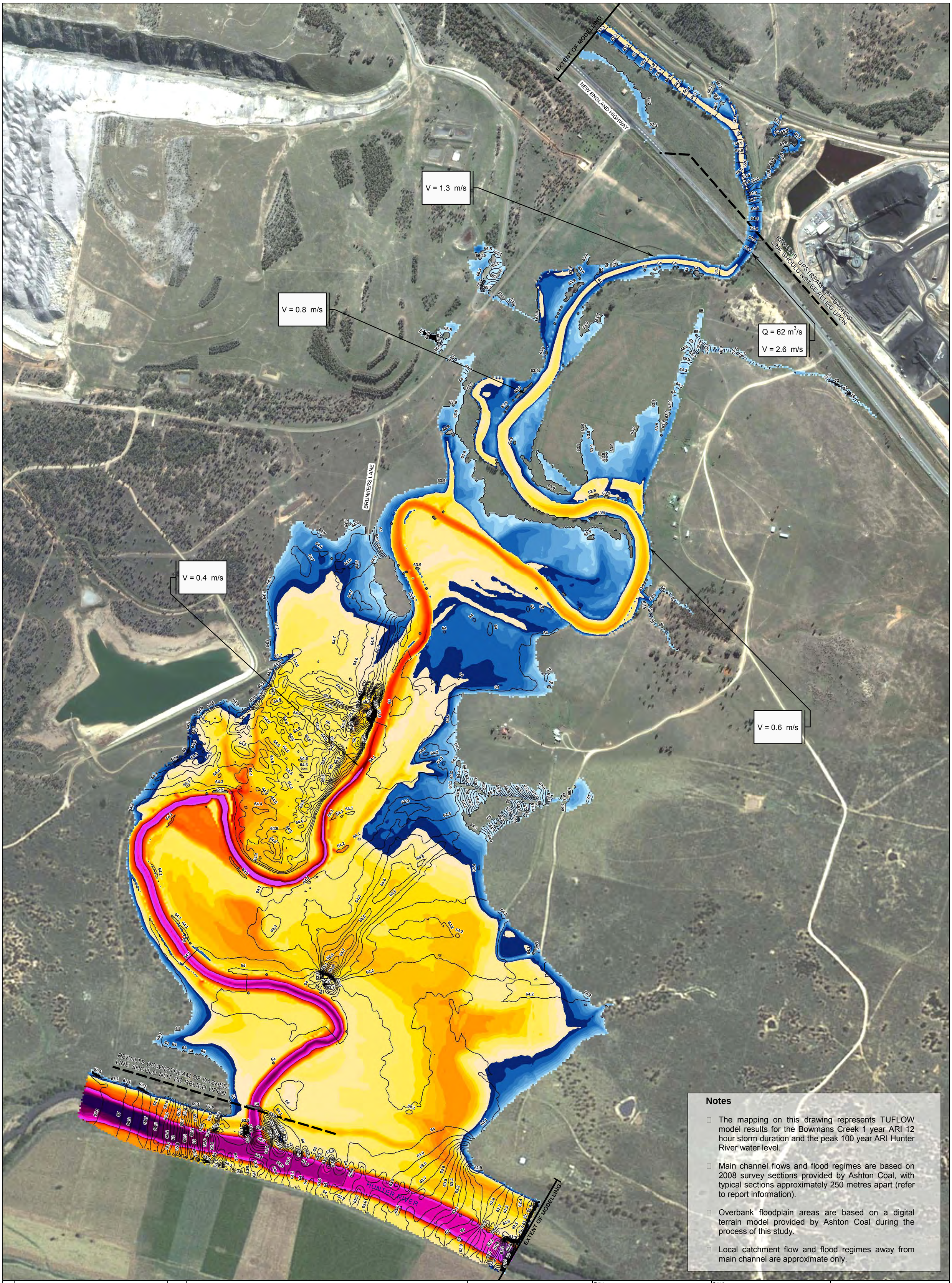
Tel: +61 (0) 2 8907 9000
Fax: +61 (0) 2 8907 9001
www.hyderconsulting.com

Drawing No.	Project No.	Issue
G001	AA002659	03



Notes

- The mapping on this drawing represents TUFLOW model results for the Bowmans Creek 1 year ARI 12 hour storm duration and the peak 100 year ARI Hunter River water level.
- Main channel flows and flood regimes are based on 2008 survey sections provided by Ashton Coal, with typical sections approximately 250 metres apart (refer to report information).
- Overbank floodplain areas are based on a digital terrain model provided by Ashton Coal during the process of this study.
- Local catchment flow and flood regimes away from main channel are approximate only.

Issue	Description	Date
	FINAL	28.09.09

LEGEND

Flood Depth (*m*)

0.0 - 0.1	2.0 - 2.5	6.0 - 6.5	10 - 11
0.1 - 0.2	2.5 - 3.0	6.5 - 7.0	11 - 12
0.2 - 0.4	3.0 - 3.5	7.0 - 7.5	12 - 13
0.4 - 0.6	3.5 - 4.0	7.5 - 8.0	13 - 14
0.6 - 0.8	4.0 - 4.5	8.0 - 8.5	14 - 15
0.8 - 1.0	4.5 - 5.0	8.5 - 9.0	15 - 16
1.0 - 1.5	5.0 - 5.5	9.0 - 9.5	16 - 17
1.5 - 2.0	5.5 - 6.0	9.0 - 10	17 - 18

1.5 Flood Level Contours (m AHD)

V = __ m/s Representative Within Channel Velocities

0 80 160 240 320 400 m

Client: AshtonCoal

Status			
Scales	1 : 5 000	Current Issue Signatures	
		Drawn	DN
Original Size	A1	Designed	DC
Datum	GDA94	Checked	DC
Projection	MGA56	Approved	BC
Filename	G005_AA002659_04_BOWMANSCK_1YEARARI_100WATER_090928.MXD		

Project: BOWMANS CREEK

Title: 1 YEAR ARI FLOOD DEPTH AND FLOOD CONTOURS FOR EXISTING CONDITIONS ASSUMING PEAK 100 YEAR ARI HUNTER RIVER WATER LEVEL

HYDER CONSULTING PTY LTD
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North Sydney NSW 2060
Australia
Tel: +61 (0) 2 8907 9000
Fax: +61 (0) 2 8907 9001
www.hyderconsulting.com

Drawing No.	Project No.	Issue
G005	AA002659	04

Annexure D

TUFLOW Model Results – Proposed Conditions

Bowmans Creek 1 year Proposed Condition Flow Regimes with Low Hunter River Water Level

Bowmans Creek 5 year Proposed Condition Flow Regimes with Low Hunter River Water Level

Bowmans Creek 20 year Proposed Condition Flow Regimes with Low Hunter River Water Level

Bowmans Creek 100 year Proposed Condition Flow Regimes with Low Hunter River Water Level

Bowmans Creek 1 year Proposed Condition Flow Regimes with 100 year Hunter River Water Level

EXTENT OF MODELLING

NEW ENGLAND HIGHWAY

RESULTS UPSTREAM OF DASHED LINE SHOULD NOT BE RELIED UPON

Q = 62 m^3/s

V = 2.9 m/s

BRUNKERS LANE

V = 3.3 m/s

V = 1.6 m/s

V = 2.0 m/s

V = 2.4 m/s

Q = 63 m^3/s

V = 2.0 m/s

RESULTS DOWNSTREAM OF DASHED LINE SHOULD NOT BE RELIED UPON

HUNTER RIVER

EXTENT OF MODELLING

Notes

- The mapping on this drawing represents TUFLOW model results for the 1 year ARI 12 hour storm duration.
- Main channel flows and flood regimes are based on 2008 survey sections provided by Ashton Coal, with typical sections approximately 250 metres apart (refer to report information).
- Overbank floodplain areas are based on a digital terrain model provided by Ashton Coal during the process of this study.
- Local catchment flow and flood regimes away from main channel are approximate only.

Issue	Description	Date
	FINAL	28.09.09

LEGEND

Flood Depth (*m*)

0.0 - 0.1	2.0 - 2.5
0.1 - 0.2	2.5 - 3.0
0.2 - 0.4	3.0 - 3.5
0.4 - 0.6	3.5 - 4.0
0.6 - 0.8	4.0 - 4.5
0.8 - 1.0	4.5 - 5.0
1.0 - 1.5	
1.5 - 2.0	

1.5 Flood Level Contours (m AHD)

V = __ m/s Representative Within Channel Velocities

0 100 200 300 400 500 m

Client: AshtonCoal

Status			
Scales	1 : 5 000	Current Issue Signatures	
		Drawn	DN
Original Size	A1	Designed	DC
Datum	GDA94	Checked	DC
Projection	MGA56	Approved	BC
Filename	G008_AA002659_01_PROPOSED_BOWMANSCK_1YEARARI_FLOOD_090909.MXD		

Project: BOWMANS CREEK

Title: 1 YEAR ARI FLOOD DEPTH AND FLOOD CONTOURS FOR PROPOSED CONDITIONS ASSUMING LOW HUNTER RIVER LEVEL

HYDER CONSULTING PTY LTD
ABN 76 104 485 289
Level 5, 141 Walker St
North Sydney NSW 2060
Australia
Tel: +61 (0) 2 8907 9000
Fax: +61 (0) 2 8907 9001
www.hyderconsulting.com

Drawing No.	Project No.	Issue
G008	AA002659	01

EXTENT OF MODELLING

NEW ENGLAND HIGHWAY

RESULTS UPSTREAM OF DASHED LINE SHOULD NOT BE RELIED UPON

Q = 155 m^3/s

V = 3.0 m/s

BRUNKERS LANE

V = 3.2 m/s

V = 2.1 m/s

V = 3.7 m/s

V = 2.5 m/s

Q = 151 m^3/s

V = 2.5 m/s

RESULTS DOWNSTREAM OF DASHED LINE SHOULD NOT BE RELIED UPON

HUNTER RIVER

EXTENT OF MODELLING

Notes

- The mapping on this drawing represents TUFLOW model results for the 5 year ARI 18 hour storm duration.
- Main channel flows and flood regimes are based on 2008 survey sections provided by Ashton Coal, with typical sections approximately 250 metres apart (refer to report information).
- Overbank floodplain areas are based on a digital terrain model provided by Ashton Coal during the process of this study.
- Local catchment flow and flood regimes away from main channel are approximate only.

Issue	Description	Date
	FINAL	28.09.09

LEGEND

Flood Depth (*m*)

0.0 - 0.1	2.0 - 2.5	6.0 - 6.5
0.1 - 0.2	2.5 - 3.0	6.5 - 7.0
0.2 - 0.4	3.0 - 3.5	7.0 - 7.5
0.4 - 0.6	3.5 - 4.0	7.5 - 8.0
0.6 - 0.8	4.0 - 4.5	8.0 - 8.5
0.8 - 1.0	4.5 - 5.0	
1.0 - 1.5	5.0 - 5.5	
1.5 - 2.0	5.5 - 6.0	

1.5 Flood Level Contours (m AHD)

V = __ m/s Representative Within Channel Velocities

0 100 200 300 400 500 m

Client: AshtonCoal

Status			
Scales	1 : 5 000	Current Issue Signatures	
		Drawn	DN
Original Size	A1	Designed	DC
Datum	GDA94	Checked	DC
Projection	MGA56	Approved	BC
Filename	G007_AA002659_01_PROPOSED_BOWMANSCK_5YEARARI_FLOOD_090909.MXD		

Project: BOWMANS CREEK

Title: 5 YEAR ARI FLOOD DEPTH AND FLOOD CONTOURS FOR PROPOSED CONDITIONS ASSUMING LOW HUNTER RIVER LEVEL

HYDER CONSULTING PTY LTD
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Level 5, 141 Walker St
North Sydney NSW 2060
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Drawing No.	Project No.	Issue
G007	AA002659	01

EXTENT OF MODELLING

NEW ENGLAND HIGHWAY

RESULTS UPSTREAM OF DASHED LINE SHOULD NOT BE RELIED UPON

Q = 318 m^3/s

V = 3.1 m/s

BRUNKERS LANE

V = 3.4 m/s

V = 2.6 m/s

V = 3.0 m/s

V = 2.4 m/s

Q = 267 m^3/s

V = 3.1 m/s

RESULTS DOWNSTREAM OF DASHED LINE SHOULD NOT BE RELIED UPON

HUNTER RIVER

EXTENT OF MODELLING

Notes

- The mapping on this drawing represents TUFLOW model results for the 20 year ARI 18 hour storm duration.
- Main channel flows and flood regimes are based on 2008 survey sections provided by Ashton Coal, with typical sections approximately 250 metres apart (refer to report information).
- Overbank floodplain areas are based on a digital terrain model provided by Ashton Coal during the process of this study.
- Local catchment flow and flood regimes away from main channel are approximate only.

Issue	Description	Date
	FINAL	28.09.09

LEGEND

Flood Depth (*m*)

0.0 - 0.1	2.0 - 2.5	6.0 - 6.5	10 - 11
0.1 - 0.2	2.5 - 3.0	6.5 - 7.0	
0.2 - 0.4	3.0 - 3.5	7.0 - 7.5	
0.4 - 0.6	3.5 - 4.0	7.5 - 8.0	
0.6 - 0.8	4.0 - 4.5	8.0 - 8.5	
0.8 - 1.0	4.5 - 5.0	8.5 - 9.0	
1.0 - 1.5	5.0 - 5.5	9.0 - 9.5	
1.5 - 2.0	5.5 - 6.0	9.0 - 10	

1.5 Flood Level Contours (m AHD)

V = __ m/s Representative Within Channel Velocities

0 90 180 270 360 450 m

Client: AshtonCoal

Status			
Scales	1 : 5 000	Current Issue Signatures	
		Drawn	DN
Original Size	A1	Designed	DC
Datum	GDA94	Checked	DC
Projection	MGA56	Approved	BC
Filename	G009_AA002659_01_PROPOSED_BOWMANSCK_20YEARARI_FLOOD_090909.MXD		

Project: BOWMANS CREEK

Title: 20 YEAR ARI FLOOD DEPTH AND FLOOD CONTOURS FOR PROPOSED CONDITIONS ASSUMING LOW HUNTER RIVER LEVEL

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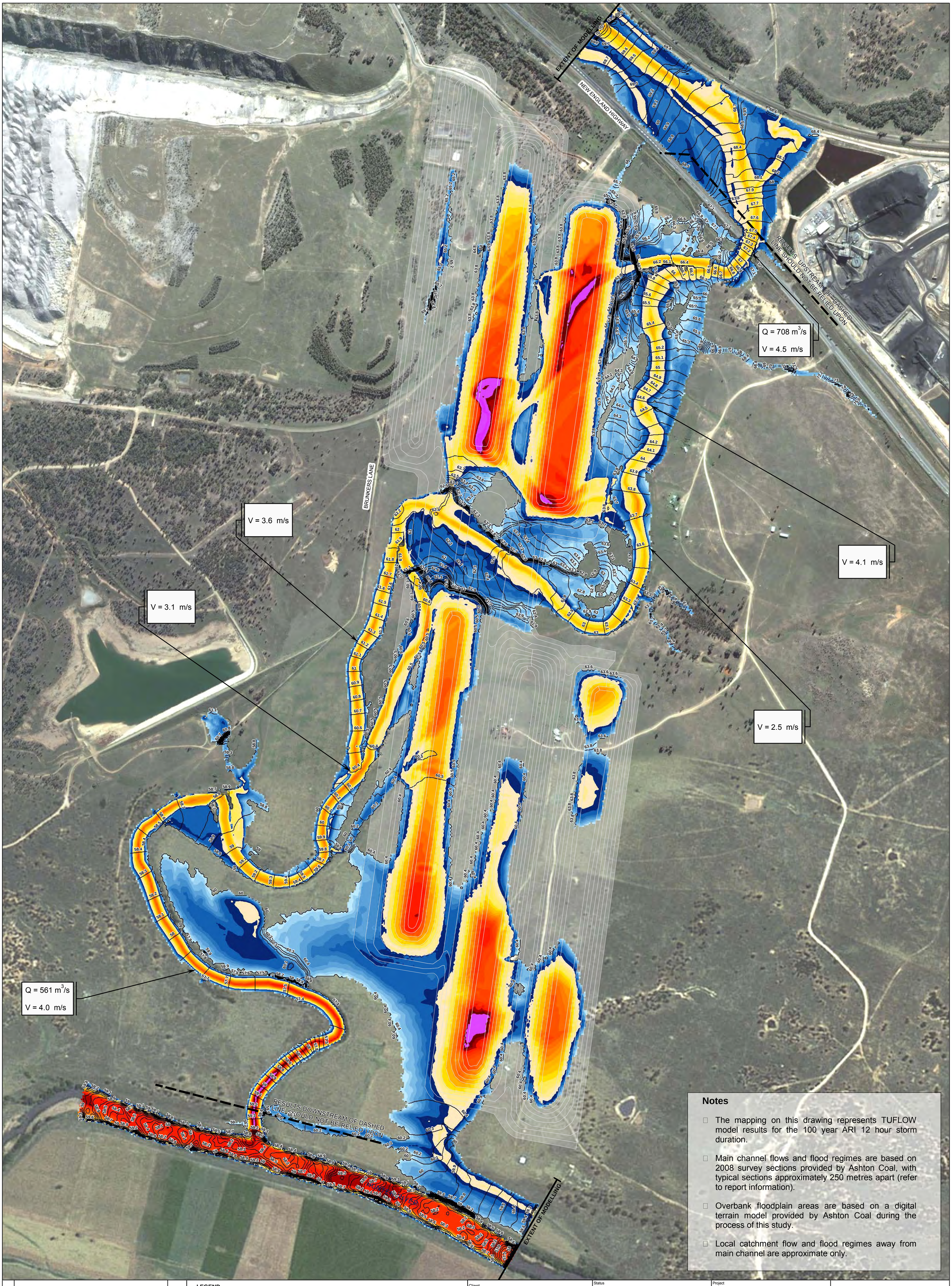
Drawing No.	Project No.	Issue
G009	AA002659	01



Notes

- The mapping on this drawing represents TUFLOW model results for the 100 year ARI 12 hour storm duration.
- Main channel flows and flood regimes are based on 2008 survey sections provided by Ashton Coal, with typical sections approximately 250 metres apart (refer to report information).
- Overbank floodplain areas are based on a digital terrain model provided by Ashton Coal during the process of this study.
- Local catchment flow and flood regimes away from main channel are approximate only.

Issue	Description	Date
	FINAL	28.09.09

LEGEND

Flood Depth (*m*)

0.0 - 0.1	2.0 - 2.5	6.0 - 6.5	10 - 11
0.1 - 0.2	2.5 - 3.0	6.5 - 7.0	11 - 12
0.2 - 0.4	3.0 - 3.5	7.0 - 7.5	
0.4 - 0.6	3.5 - 4.0	7.5 - 8.0	
0.6 - 0.8	4.0 - 4.5	8.0 - 8.5	
0.8 - 1.0	4.5 - 5.0	8.5 - 9.0	
1.0 - 1.5	5.0 - 5.5	9.0 - 9.5	
1.5 - 2.0	5.5 - 6.0	9.0 - 10	

1.5 Flood Level Contours (m AHD)

V = __ m/s Representative Within Channel Velocities

0 100 200 300 400 500 m

Client: AshtonCoal

Status	
Scales	1 : 5 000
Original Size	A1
Datum	GDA94
Projection	MGA56
Filename	G010_AA002659_01_PROPOSED_BOWMANSCK_100YEARARI_FLOOD_090909.MXD

Current Issue Signatures	
Drawn	DN
Designed	DC
Checked	DC
Approved	BC

Project: BOWMANS CREEK

Title: 100 YEAR ARI FLOOD DEPTH AND FLOOD CONTOURS FOR PROPOSED CONDITIONS ASSUMING LOW HUNTER RIVER LEVEL

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Drawing No.	Project No.	Issue
G010	AA002659	01

EXTENT OF MODELLING

NEW ENGLAND HIGHWAY

RESULTS UPSTREAM OF DASHED LINE SHOULD NOT BE RELIED UPON

Q = 62 m^3/s

V = 2.9 m/s

BRUNKERS LANE

V = 0.2 m/s

V = 1.5 m/s

V = 1.7 m/s

V = 0.5 m/s

RESULTS DOWNSTREAM OF DASHED LINE SHOULD NOT BE RELIED UPON

HUNTER RIVER

EXTENT OF MODELLING

Notes

- The mapping on this drawing represents TUFLOW model results for the Bowmans Creek 1 year ARI 12 hour storm duration and the peak 100 year ARI Hunter River water level.
- Main channel flows and flood regimes are based on 2008 survey sections provided by Ashton Coal, with typical sections approximately 250 metres apart (refer to report information).
- Overbank floodplain areas are based on a digital terrain model provided by Ashton Coal during the process of this study.
- Local catchment flow and flood regimes away from main channel are approximate only.

Issue	Description	Date
	FINAL	28.09.09

LEGEND

Flood Depth (*m*)

0.0 - 0.1	2.0 - 2.5	6.0 - 6.5	10 - 11
0.1 - 0.2	2.5 - 3.0	6.5 - 7.0	11 - 12
0.2 - 0.4	3.0 - 3.5	7.0 - 7.5	12 - 13
0.4 - 0.6	3.5 - 4.0	7.5 - 8.0	13 - 14
0.6 - 0.8	4.0 - 4.5	8.0 - 8.5	14 - 15
0.8 - 1.0	4.5 - 5.0	8.5 - 9.0	15 - 16
1.0 - 1.5	5.0 - 5.5	9.0 - 9.5	16 - 17
1.5 - 2.0	5.5 - 6.0	9.0 - 10	17 - 18

1.5 Flood Level Contours (m AHD)

V = __ m/s Representative Within Channel Velocities

0 80 160 240 320 400 m

Client: AshtonCoal

Status			
Scales	1 : 5 000	Current Issue Signatures	
		Drawn	DN
Original Size	A1	Designed	DC
Datum	GDA94	Checked	DC
Projection	MGA56	Approved	BC

Filename G011_AA002659_02_PROPOSED_BOWMANSCK_1YEARARI_100WATER_090928.MXD

Project: BOWMANS CREEK

Title: 1 YEAR ARI FLOOD DEPTH AND FLOOD CONTOURS FOR PROPOSED CONDITIONS ASSUMING PEAK 100 YEAR ARI HUNTER RIVER WATER LEVEL

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Drawing No.	Project No.	Issue
G011	AA002659	02