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Cross section, scour chain and particle size data in the Ngarradj catchment for 2004

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September 2005

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Contents

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1 Introduction

The first field inspections were conducted in the Ngarradj catchment during the dry season of 1998 as initial work on the Jabiluka project had commenced. Erskine et al (2001) proposed that a sediment budget framework should be adopted by ***eriss*** to assess the physical impacts, if any, of the Jabiluka project on the Ngarradj catchment (fig 1). During these field trips, various fluvial erosion processes were identified (Erskine et al 2001). Bank erosion and scour and fill of the sandy creek beds were observed as active processes.

To measure the amount of large-scale bank erosion permanently marked channel cross sections were installed on the project area tributaries (Tributaries North and Central) and at the three ***eriss*** gauging stations (Moliere et al 2002) (fig 1). Scour chains were used at some of the above cross sections to measure scour and fill (Saynor 2000, Erskine et al 2001). Bulk samples of bed material were collected for particle size analysis from each cross section (Saynor 2000, Erskine et al 2001). The complete ***eriss*** field program initiated in the Ngarradj catchment to assess the physical impacts of the Jabiluka project is described in Saynor et al (2001).

The results for the annual cross sections surveys, bulk bed material particle size distribution and scour and fill measurements in the Ngarradj catchment between 1998 and 2003 are presented in the following reports;

- Cross section change data, 1998 to 2001 – Saynor et al (2002a),
- Scour and fill by scour chains, 1998 to 2001 – Saynor et al (2002b),
- Cross section and scour chain data, 2002 to 2003 – Saynor et al (2004a),
- Bed material grain size data, 1998 to 2003 – Saynor et al (2004b),
- Analysis of cross section and scour and fill changes, 1998 to 2003 - Saynor et al (2004c),
- Analysis of bed material grains size changes, 1998 to 2003 – Saynor et al (2005)

This report contains the data for cross sections, scour chains and particle size distributions for the Ngarradj catchment for 2004.

2 Methods

Fifty six permanently marked channel cross sections were installed along various reaches of Ngarradj Creek. Multiple cross sections were installed at each ***eriss*** gauging station (upper Swift Creek, lower Swift Creek and East Tributary) as well as on the project area tributaries, Tributary North and Tributary Central (fig 1). At all of these cross sections, bulk bed material samples were collected annually. At some of these cross sections scour chains were also installed in the channel bed.

During each wet season, the various grain size fractions of the bed material of Ngarradj Creek and its tributaries are reworked and transported downstream at various rates to a number of sediment storages. Although the bed material fluxes have been measured during the wet season (Erskine et al 2001), it is also important to know both the depth to which the bed is

scoured and/or aggraded each wet season and the particle size of the bed material. Repeated surveys of permanently marked cross sections, as reported by Saynor et al (2002a), only measure the net change between successive wet seasons. The actual depths of scour and fill during the wet season are usually much greater. The channels will be one of the first temporary stores to receive sediment, if any is generated by mining activities (Erskine et al 2001) thus it is important to gain and understanding of scour/fill that can occur. Therefore, scour chains were used at some of the above cross sections to determine scour and fill during each wet season.

2.1 Channel cross sections

A series of permanently marked cross sections were installed during the 1998 dry season and have been surveyed annually each subsequent dry season. The data obtained and plots of every survey for the years 1998 to 2003 inclusive have been documented previously (Saynor et al 2002a, 2004a). The background information and the complete methodology are contained in Saynor et al (2001) and Erskine et al (2001).

The cross sections were marked using a star picket driven into the ground with the top 0.3 m encased with a circular concrete collar (plinth) at each end of the cross section. A coach bolt was set into the concrete (with a small drill hole in the top) to provide an accurate benchmark. At one end of each cross section a recovery star picket was installed near the concrete plinth. These cross sections were surveyed using a Topcon Total Station during each dry season between 1998 and 2004 to determine the net change in channel cross section during each intervening wet season. This approach follows the Vigil Network method of the US Geological Survey developed for the International Hydrological Decade (Leopold 1962, Emmett 1965, Leopold & Emmett 1965, Emmett & Hadley 1968).

2.2 Bulk bed material samples

Bulk samples of specific depositional environments are the accepted method of sampling fluvial sediments (Kellerhals & Bray 1971). This involves the collection of all material from a predetermined volume within a specific depositional or geomorphic environment (Kellerhals & Bray 1971). Where collection of all sediment from a specific depositional environment is impossible because the mass is too large for collection, transport and/or analysis, sub-sampling is practised.

However, there are potential problems with bulk sampling that must be recognised. Very large sample masses are required to obtain reproducible measures of the grain size distributions of samples containing individual large clasts or gravels (de Vries 1970; Church et al 1987; Gale & Hoare 1992; Ferguson & Paola 1997). Recommended minimum sample mass also depends on sediment sorting or the range of the grain size distribution (Gale & Hoare 1994; Ferguson & Paola 1997). For a particular depositional environment, poorly sorted sediments, such as found in mixed sand- and gravel-bed rivers, require larger masses than better sorted samples (Gale & Hoare 1994; Ferguson & Paola 1997). Bulk sampling is also usually restricted to small areas that may not be representative of all of a specific depositional environment (Wolman 1954; Muir 1969). This is a major concern in large rivers with spatially variable depositional environments (Mosley & Tindale 1985) but should not be a significant problem in the small channels in the Ngarradj catchment.

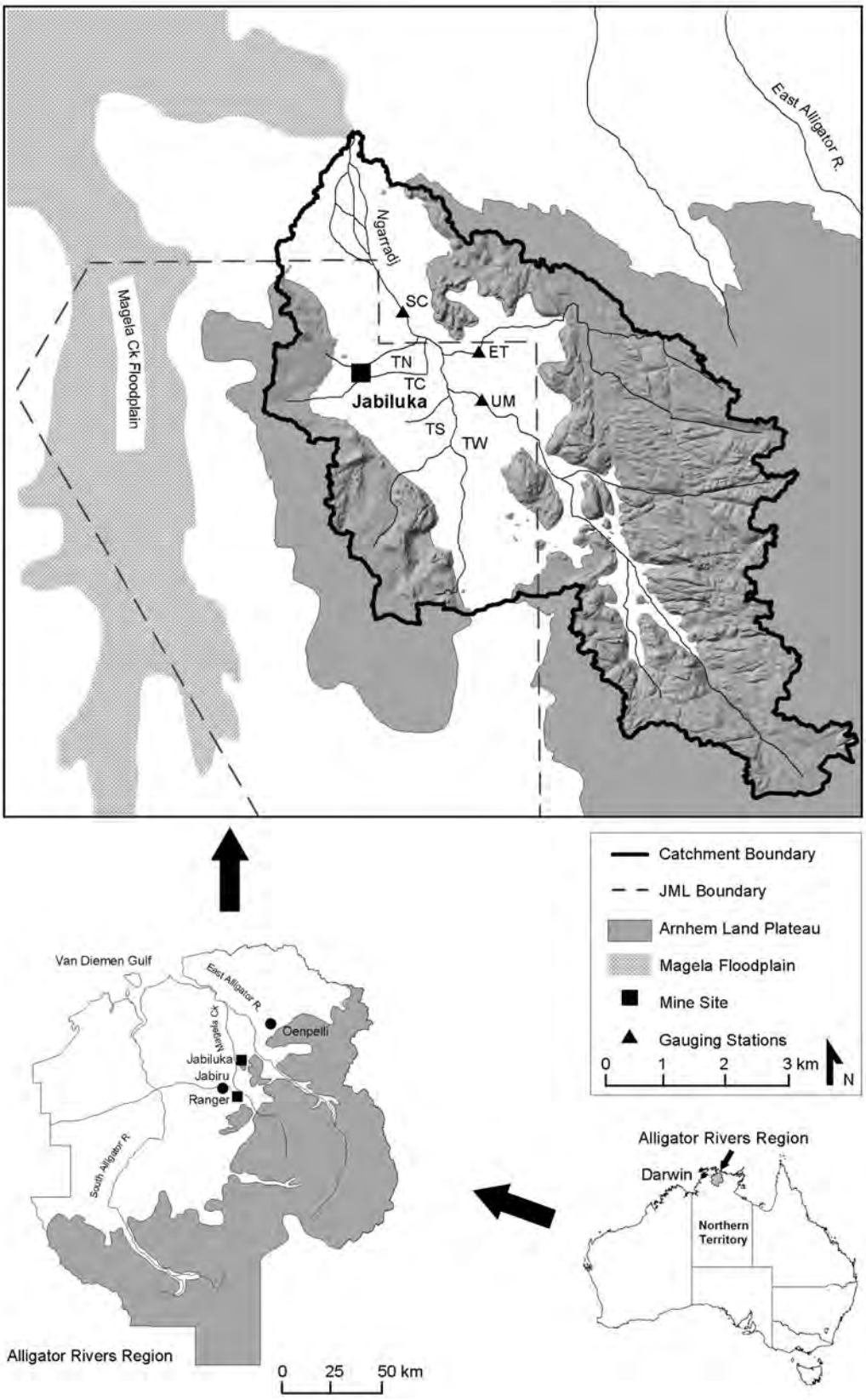

Figure 1 The Ngarradj catchment showing the location of the Jabiluka Mineral Lease, ***eriss***'s gauging stations and local creek names. SC refers to Swift Creek gauging station, TN Tributary North, ET East Tributary gauging station, TC Tributary Central, TS Tributary South, TW Tributary West and UM upper Swift Creek gauging station.

Bulk bed material samples were collected by a trowel or small spade from at least 3 equally spaced points across the stream bed. The samples are collected by taking a pace across the bed and with eyes closed the trowel or small spade is use to sample the top 5-8 cm of the bed. This process is repeated across the width of the stream bed. Each individual sample is then combined into a single sample for each of the 56 cross sections throughout the Ngarradj catchment.

2.2.1 Laboratory methods

All bulk bed material samples were oven dried at 105°C for 24 hours before being subjected to particle size analysis. Initial field observations indicated that there was little mud (i.e.< 0.063 mm in diameter) present in the upper Swift Creek and East Tributary gauging station reaches. The phi (ϕ) notation system is often used to describe the grain size of clastic sediment by sedimentologists. It is a logarithmic scale in which each non-logarithmic grade limit is twice as large as the next smaller grade limit (Folk 1974) and is denoted by:

$$\phi = -\log_2 d \qquad (1)$$

where d is the grain diameter in mm.

The gravel fraction of the samples was manually sieved in its entirety at $\phi/2$ intervals. If the fraction less than 2 mm in diameter (fine earth fraction) was greater than 150 g it was passed through a riffle box to obtain a sample of approximately 100 g to ensure that the analytical stainless steel sieves were not damaged by excessive loading. This sub-sample was then dry sieved through a nest of stainless steel sieves at $\phi/2$ intervals using a 15 minutes shake time. For sample masses less than 150 g, the sample was sieved in its entirety.

Field observations of the mine site tributaries (Tributary North and Tributary Central) indicated that the mud fraction comprised a larger proportion of the bed material than in other channels. All samples in these reaches (mine site tributaries) were therefore subjected to a simplified particle size analysis according to the sieve and hydrometer method of Gee and Bauder (1986). They were chemically dispersed with 25 mL of sodium hexametaphosphate before being mechanically dispersed on a shaking wheel or a shaking platform for at least 12 hours. The sample was then wet sieved through a 0.063 mm or 4 ϕ stainless steel sieve. The retained sand fraction was oven dried, weighed and dry sieved through a nest of sieves at $\phi/2$ intervals, as outlined above. In the complete hydrometer method of Gee and Bauder (1986), material passing through a 0.063 mm or 4 ϕ stainless steel sieve is usually transferred to a 1000 mL cylinder for hydrometer analysis. Given the relatively small amounts of material less than 0.063mm that were generally obtained from the Ngarradj samples the hydrometer step was not required. The masses and cumulative percentage are shown in Appendix B.

2.2.2 Sediment texture

The sediment textural classification system developed by Folk (1954; 1974) was used for all fluviatile samples of unconsolidated materials. It is based on a ternary diagram showing the proportions of gravel, sand and mud on separate axes (fig 2). This texture triangle is split into 15 groups and the median diameter is determined, where possible, for each component fraction. Each sediment fraction can be expressed in terms of one of the Wentworth size classes (table 1). To place a sample into one of the 15 major groups, only two properties need to be determined, namely the gravel percentage (boundaries at 80, 30, 5 and a trace or < 0.01 %) and the ratio of sand to mud with boundaries at 9:1, 1:1 and 1:9 (Folk 1954; 1974). The gravel content is partly a function of the highest current velocity and the maximum grain size of the supplied sediment. The sand:mud ratio reflects the amount of winnowing (washing away of fine sediment) that has occurred.

Table 1 The Wentworth grain size scale for sediments (after Folk 1974)

Finest Grain Size Diameter (mm)	Finest Grain Size Diameter (ϕ)	Wentworth Size Class
256	-8	Boulder
64	-6	Cobble
4	-2	Pebble
2	-1	Granule
1.00	0	Very coarse sand
0.50	1	Coarse sand
0.25	2	Medium sand
0.125	3	Fine sand
0.0625	4	Very fine sand
0.031	5	Coarse silt
0.0156	6	Medium silt
0.0078	7	Fine silt
0.0039	8	Very fine silt
0.00006	14	Clay

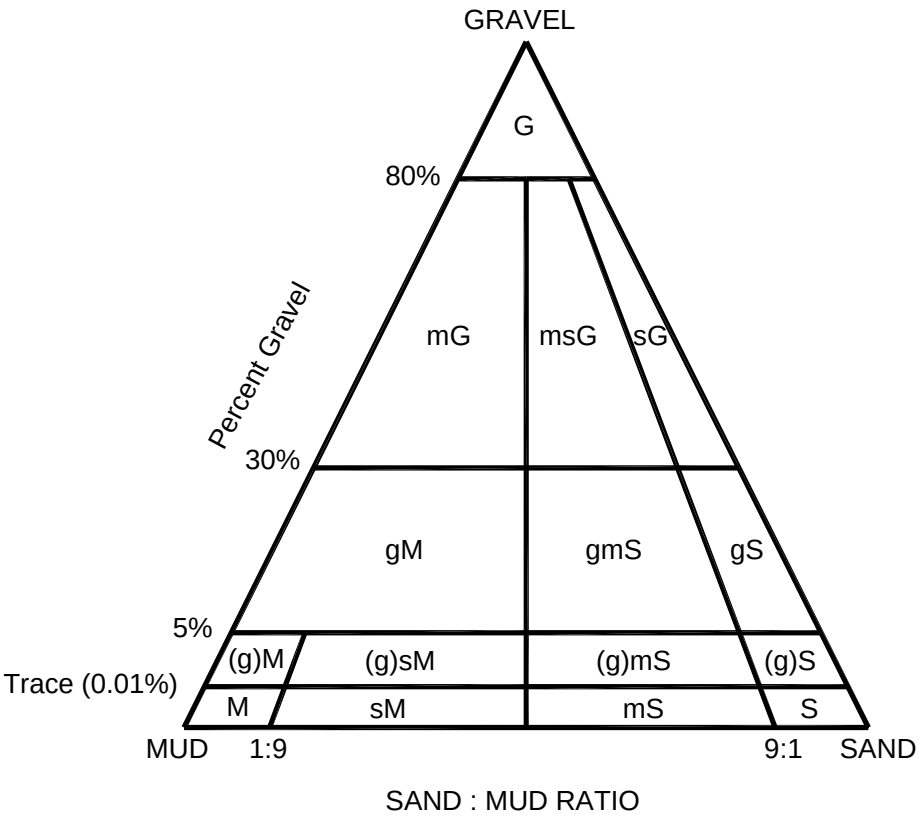

Figure 2 Folk's (1974) textural groups. G is gravel; sG sandy gravel; msG muddy sandy gravel; mG muddy gravel; gS gravelly sand; gmS gravelly muddy sand; gM gravelly mud; (g)S slightly gravelly mud; (g)mS slightly gravelly muddy sand; (g)sM slightly gravelly sandy mud; (g)M slightly gravelly mud; S sand; mS muddy sand; sM sandy mud; M mud.

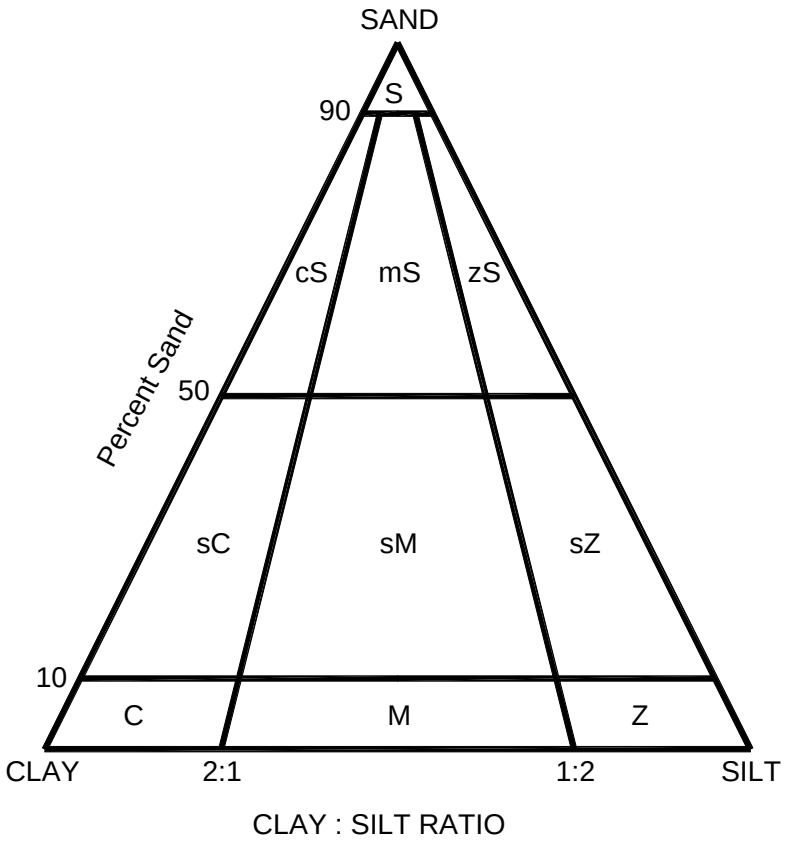

Figure 3 Folk's (1974) expansion of the bottom tier of Figure 2 to show textural classes for sediments lacking gravel. S is sand; zS silty sand; mS muddy sand; cS clayey sand; sZ sandy silt; sM sandy mud; sC sandy clay; Z silt; M mud; and C clay

2.3 Scour chains

Depths of scour and fill can be measured by scour chains, as described by Emmett & Leopold (1963) and Emmett (1965). Scour chains were installed in various reaches of the Ngarradj catchment (Table 2). After each wet season, the elevation of the stream bed was resurveyed and the bed was excavated until the chain was exposed. Figure 4 shows a scour chain that has been excavated after the cessation of flow. The chain was installed with all links vertical and Figure 4 shows that the chain from above with the links horizontal in the stream bed after the wet season. If scour had occurred, a part of the chain will be lying horizontally. The difference between the existing bed elevation and the horizontal chain was the depth of scour or fill (fig 5). It is possible to have no scour (thus no horizontal chain) but some fill (fig 5).

Scour chains were initially installed during the late dry seasons of 1998 & 1999. Table 2 contains information on the number and timing of scour chain installation in each reach. The scour chains were always located on a surveyed cross section. An aluminium tag was attached to the top link of the chain with pink flagging tape to assist with finding the chain. Only three scour chains were used on Tributary Central because bedrock, pebbles and/or clay prevented bed excavation for the installation of chains.

Table 2 Number of scour chains installed in each study reach in the Ngarradj catchment

Location	**No. of cross sections with scour chains**	**Year of initial installation**	**Total number of scour chains in each reach**
Swift Creek	3	1998 and 1999	15
East Tributary	4	1998	5
Upper Swift Creek	3	1998	6
Tributary North	5	1999	7
Tributary Central	3	1998 and 1999	3

Late in each dry season when the water table was at its lowest, the scour chains were relocated using the diagrams and measurements in Saynor et al (2001) and, more importantly, a metal detector. The metal detector was particularly effective in locating the chains. Measurements of the depth to the scour chain and the bed surface level were obtained. Figure 4 shows an example of an excavated scour chain.

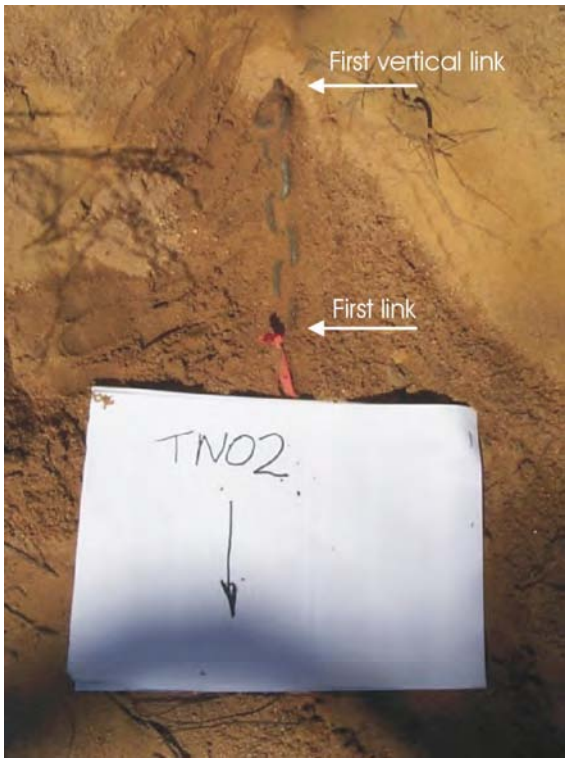

Figure 4 Scour chain at TN02 on 24 October 2000
orientated downstream. Arrow on paper shows flow direction.

A wooden board was positioned over the upstream face of the excavation and all measurements were taken to the bottom of this board which equated to the then bed level. A photograph was usually taken to show the position of the chain and an indication of the direction of flow was given by a trowel, arrow on paper, pen or ruler pointing downstream. As the scoured part of the chain was not always lying horizontal, two measurements were taken to determine the scour depth (fig 6). These were:

- Depth to top of first link (i.e. the link to which flagging tape had been tied) and
- Depth to the first vertical link.

After these measurements were made the chain was carefully straightened and then a further measurement made:

- Depth to straightened chain from the base of the wooden board.

All measurements were made as positive values except when the straightened chain was higher than the current bed level (wooden board) when the value was assigned a negative value. These measurements are used to determine scour and fill and are explained in the next section. Once all the measurements had been made, the chain was reset. If the chain could not be reset for any reason the difference was noted so that adjustments could be made to the measurements and calculations in the following years.

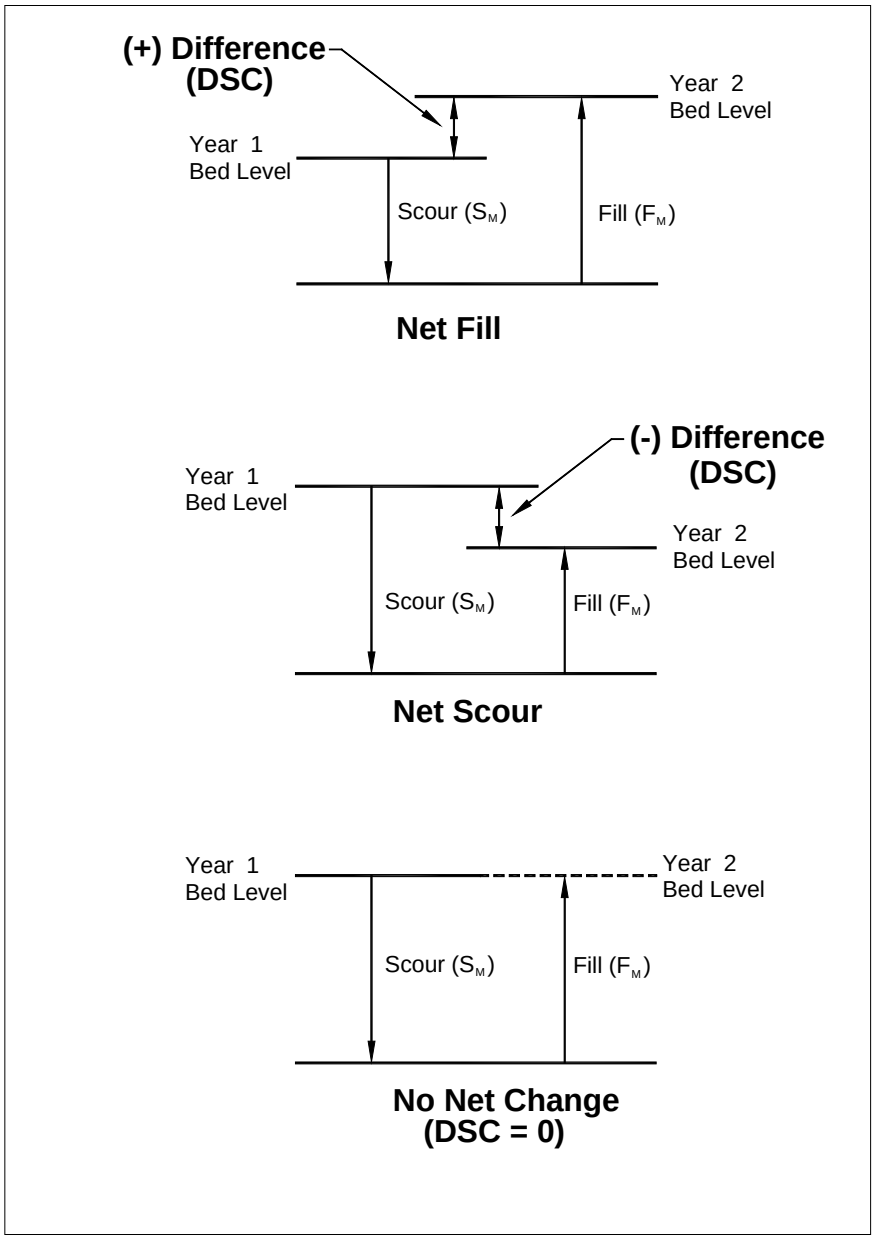

Figure 5 Three options of net channel bed change during the wet season detected by scour chains. Net fill occurs when the bed level for the 2nd year is higher than for the 1st (top). Net scour occurs when the bed level for the 2nd year is lower than for the 1st (middle). No net change occurs when the bed level for the 1st and 2nd years is the same (bottom).

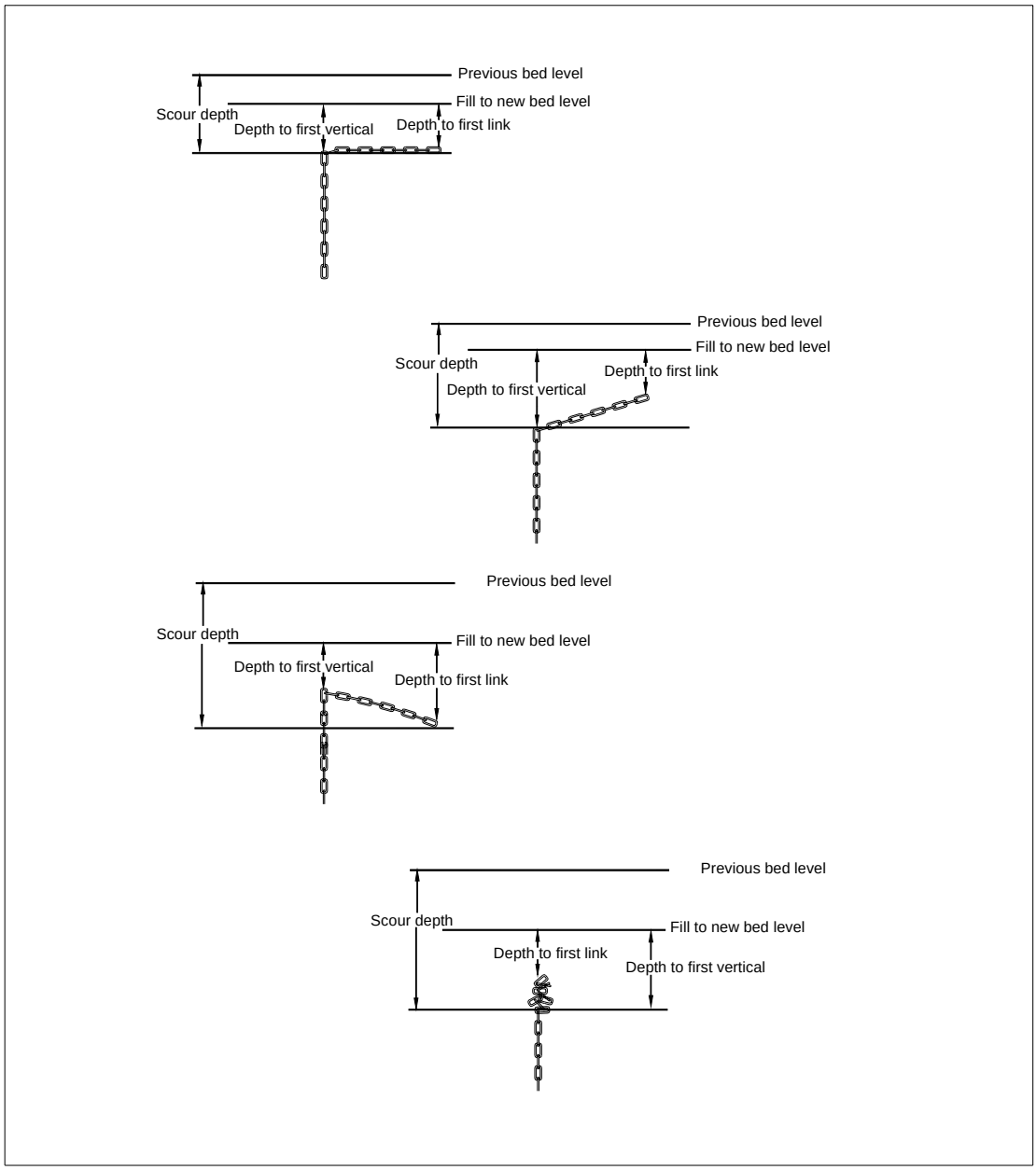

Figure 6 Diagrammatic representation of the full range of scour chain behaviour when there was net scour depicted by the middle example in figure 5. Net fill is shown by the top example in figure 5 and no change, by the lower example in figure 5.

2.4 Scour and fill calculations

The top of the highest link of each chain is the zero datum for the next wet season. The values are all made to this datum even though some of the measurements are made to the bed level for year 2 (fig 5). Once the scour chains are reset the datum is then also reset and the bed level is called Year 1 for the following year (fig 5).

The maximum amount of fill (F_M) is the actual fill during the wet season. The depth to the straightened chain (DSC) is used in equation 1 to determine the maximum scour depth (S_M) and it is essential to keep the mathematical signs as shown in figure 5.

$$S_M = F_M - DSC \qquad \text{(Eq.1)}$$

The net change in bed level (BL_N) is determined by equation 2:

$$BL_N = F_M - S_M \qquad \text{(Eq.2)}$$

A positive value indicates net fill from year 1 to year 2 and a negative value, net scour. This convention of positive values for fill and negative values for scour has been used by, among others, Emmett (1965), Leopold et al (1966), Roberts (1991), Fowler & Wilson (1995) and Locher (1997). Figure 5 shows the three possible situations, net fill, net scour and no net change.

3 Annual cross section surveys – results and discussion

The plots of the 56 cross sections for each year between 1998 and 2004 are shown below for each stream. The plot for 2004 is shown as a red line while the other cross sections are all shown as a black line. The cross section survey data for all of the sections for 1998 to 2001 are contained in Saynor et al (2002a), the survey data for all sections for 2002 and 2003 are contained in Saynor et al 2004a and the survey data for 2004 are contained in Appendix A.

3.1 Tributary North cross sections

A total of 13 cross sections were installed on this channel downstream of the Jabiluka project area in the floodout and gullied reaches (Erskine et al 2001). A tributary joins Tributary North on the left bank approximately 30 m upstream of the confluence with Ngarradj. Several cross sections include both the main channel as well as the tributary (fig 7). Four cross sections (10, 11, 12 & 13) of an unchanneled section in the floodout were also surveyed. The plots of the cross sections are shown in figures 9 to 20.

In comparison to the incised channels discussed in Darby and Simon (1999), the gullied lower reach of Tributary North is slowly developing by the upstream migration of the primary nickpoint and subsequent channel widening and degradation. The nickpoint was surveyed each year and the upstream migration of the nickpoint is shown in figure 8. These geomorphic processes were occurring before the development of the Jabiluka project (at a rate of ≈ 1.75m/yr) and these rates of activity do not appear to have been accelerated by the project activity.

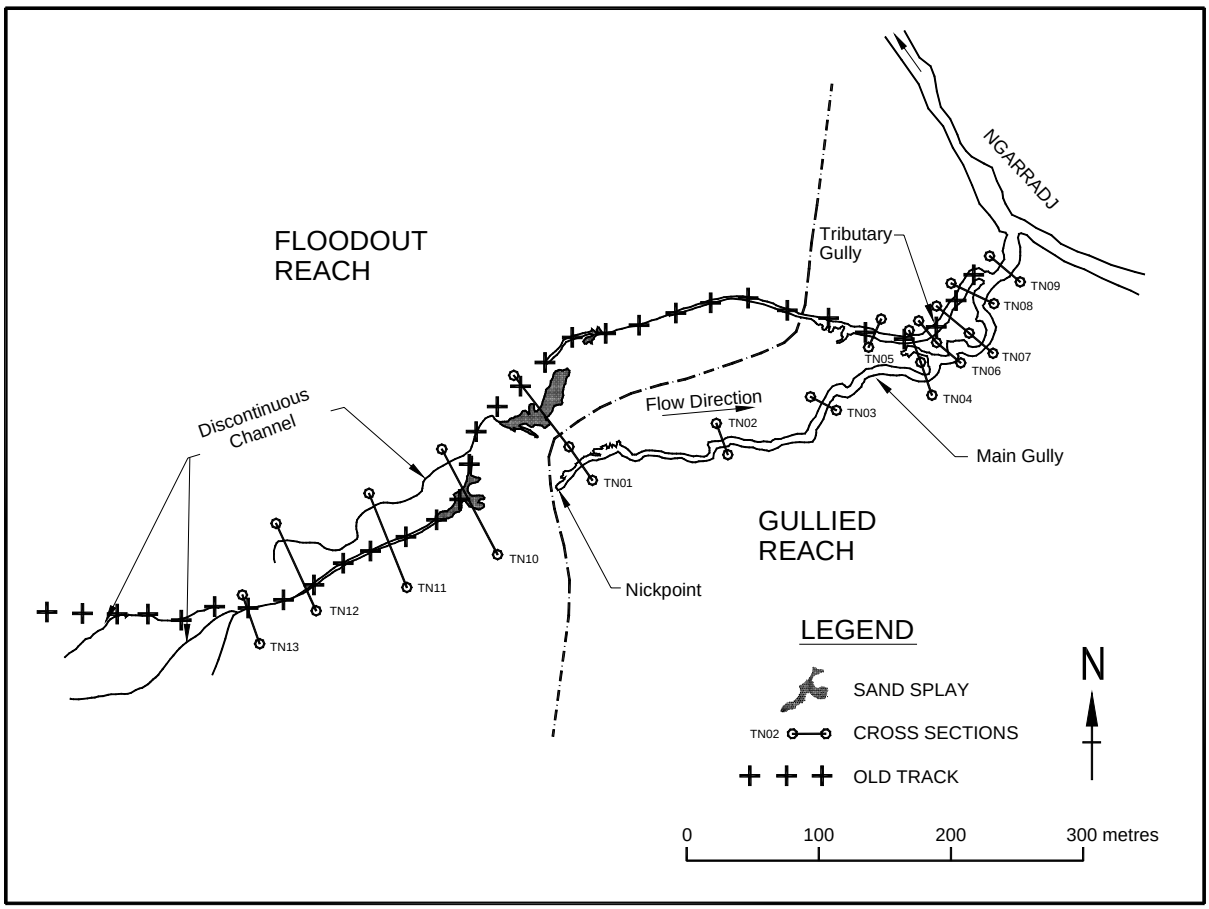

Figure 7 Location of the permanently monumented cross sections on Tributary North

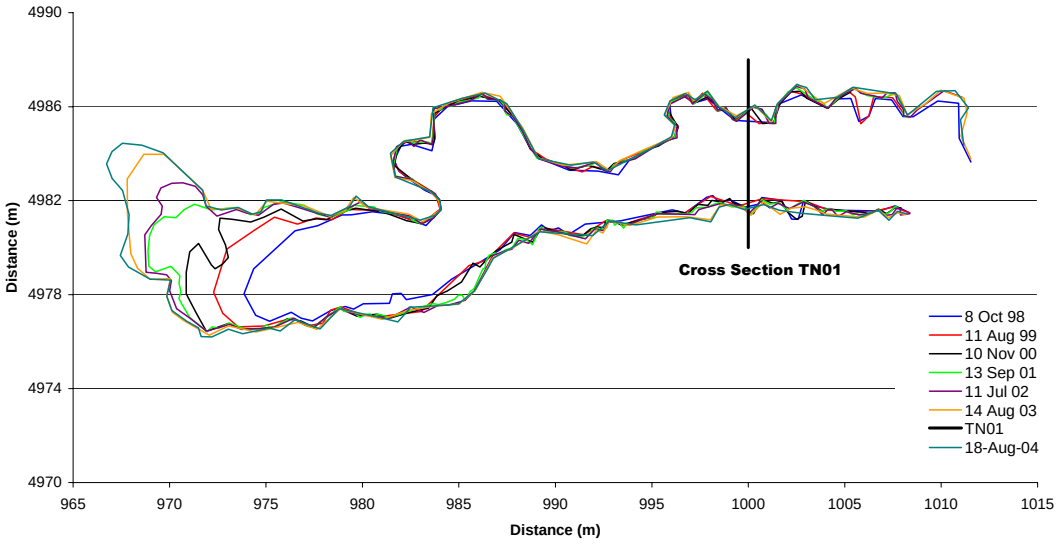

Figure 8 Annual surveys of the primary nickpoint at the head of Erskine et al's (2001) gullied reach on Tributary North. This refers to the main gully.

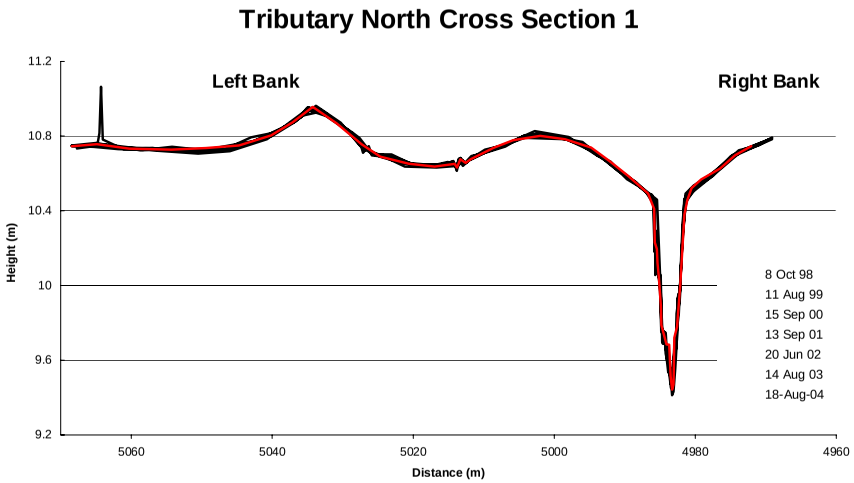

Figure 9 Tributary North cross section 1

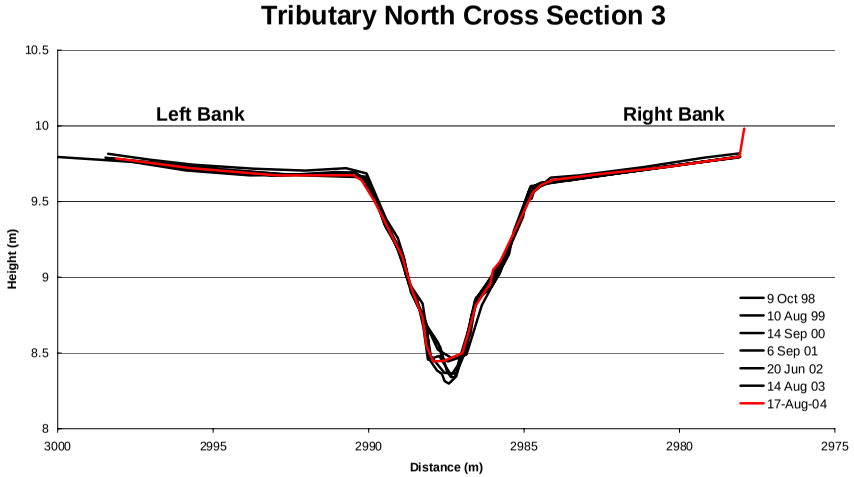

Figure 10 Tributary North cross section 3

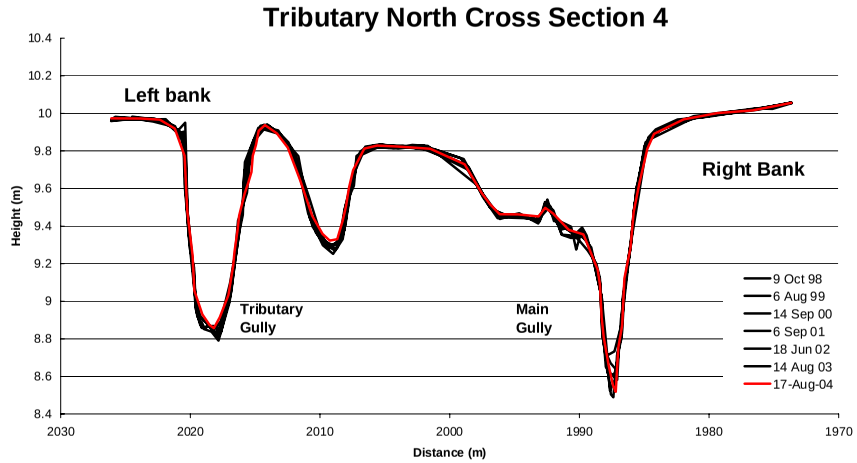

Figure 11 Tributary North cross section 4

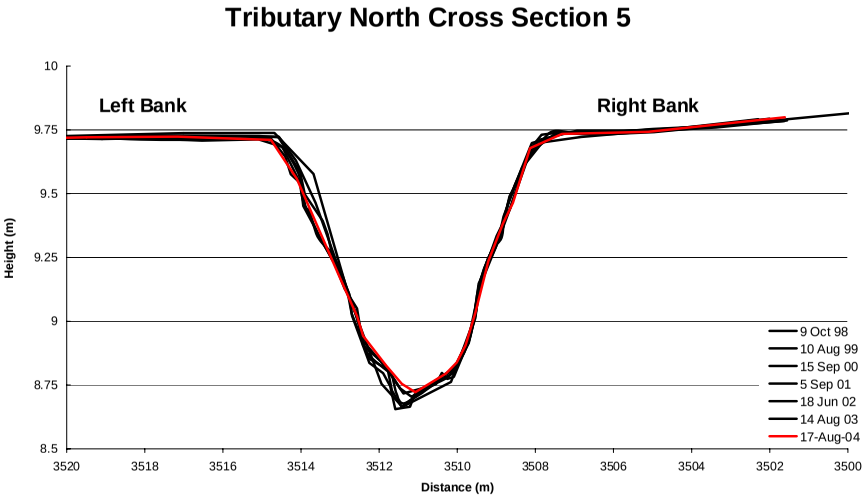

Figure 12 Tributary North cross section 5

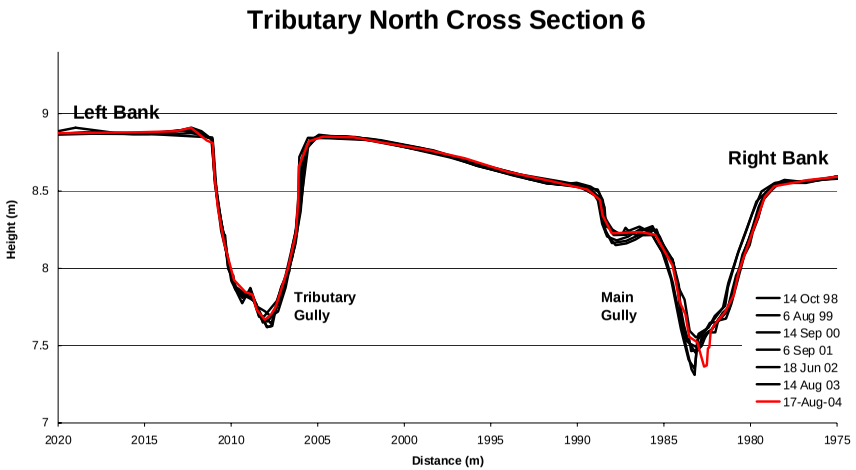

Figure 13 Tributary North cross section 6

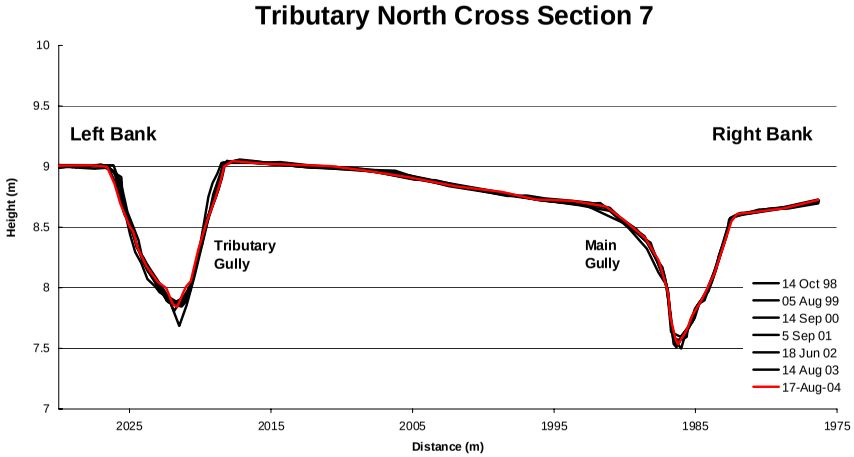

Figure 14 Tributary North cross section 7

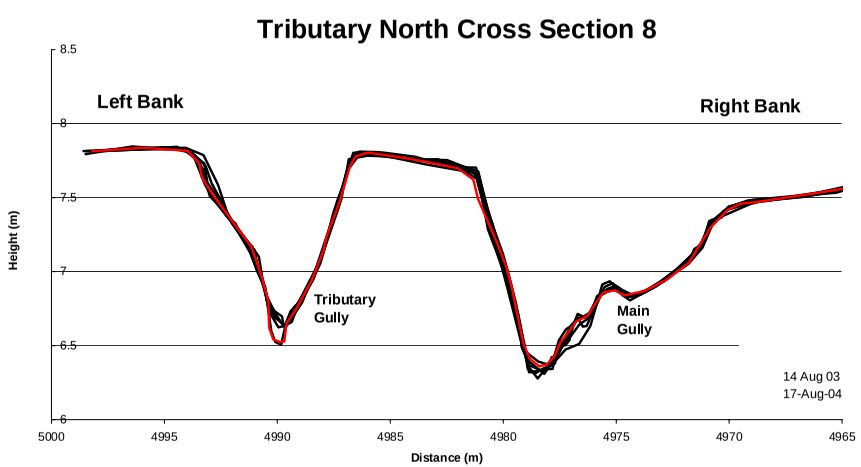

Figure 15 Tributary North cross section 8

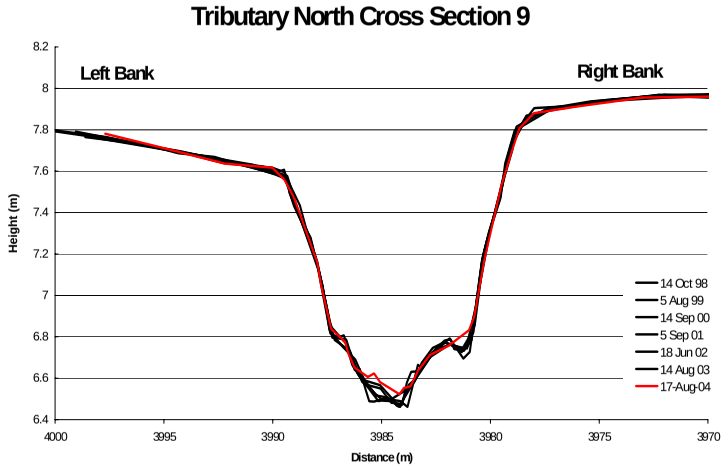

Figure 16 Tributary North cross section 9

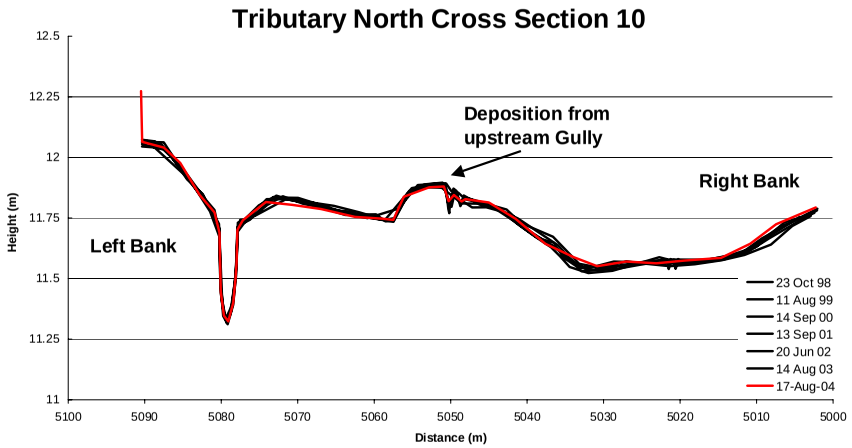

Figure 17 Tributary North cross section 10

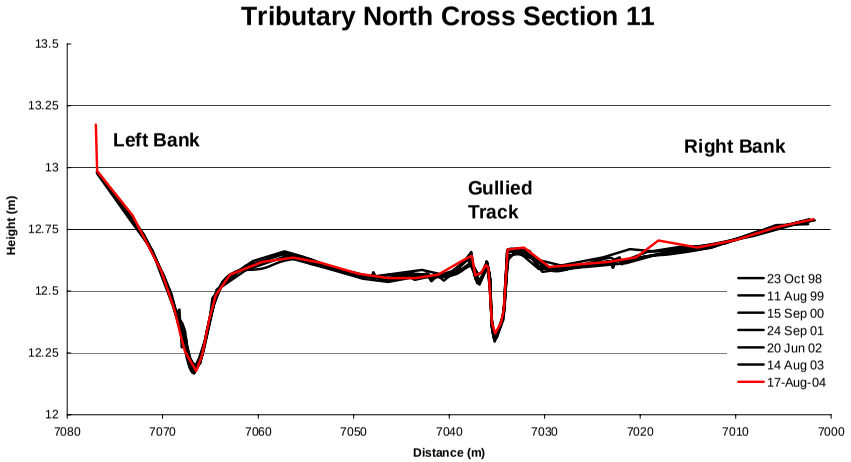

Figure 18 Tributary North cross section 11

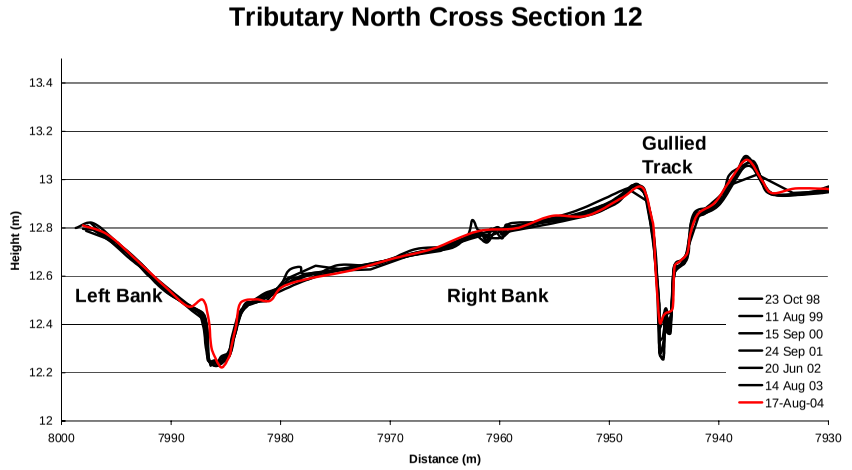

Figure 19 Tributary North cross section 12

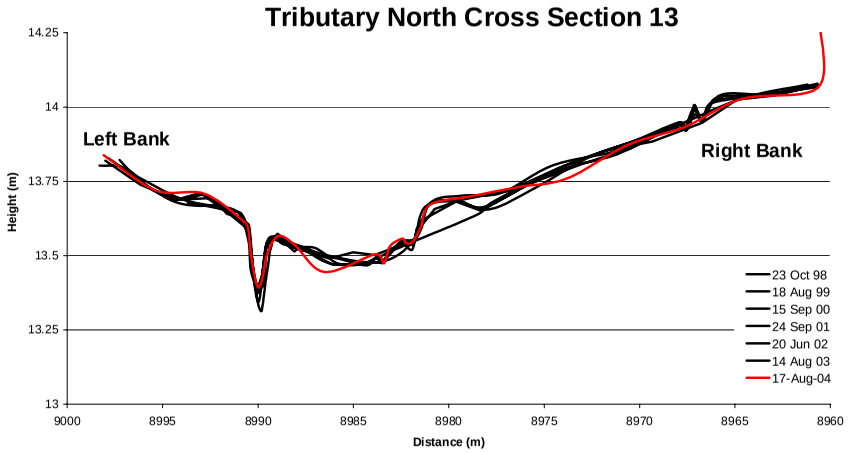

Figure 20 Tributary North cross section 13

3.2 Tributary Central Cross sections

The locations of the 15 cross sections on Tributary Central downstream of the Jabiluka project area are shown in figure 21. The most upstream sites, 6 and 7, comprise three cross sections (called A, B & C) on two abrupt angled bends in the sinuous reach (Erskine et al 2001). They were selected to determine the amount of bank erosion and lateral migration on meander loops. The remaining cross sections were located in the large and small capacity reaches which extend from the sinuous reach to the anabranch of Ngarradj (Erskine et al 2001). Two cross sections (sites TC08 and TC09) were located in the large capacity reach and the remaining six sections were sited in the small capacity reach. Bank height and channel capacity decrease rapidly downstream so that the channel is poorly defined where Tributary Central joins the anabranch of Ngarradj. The plots of the cross sections are shown in figures 22 to 36.

Channel erosion by lateral migration, bed degradation and channel widening is active on Tributary Central. Saynor et al (2004c) show that Tributary Central was prior to the development of the Jabiluka project. However, significant overbank deposition has also occurred on the floodplain in the small capacity reach where crevasses and splays are common. Sand deposition has formed a low angle fan which is well vegetated. Anabranches are developing and avulsions seem likely. While sand has been supplied to the anabranch, it terminates further downstream in a well defined sand front and is not being transported through to Ngarradj.

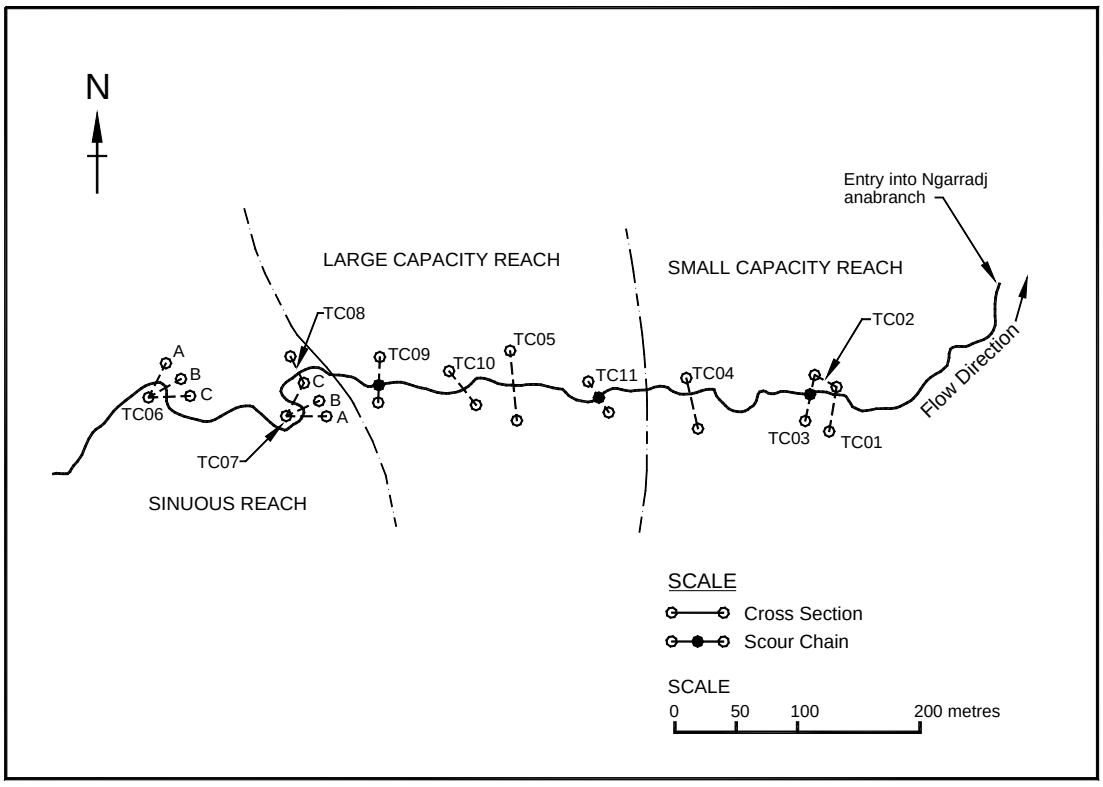

Figure 21 Location of the permanently monumented cross sections on Tributary Central

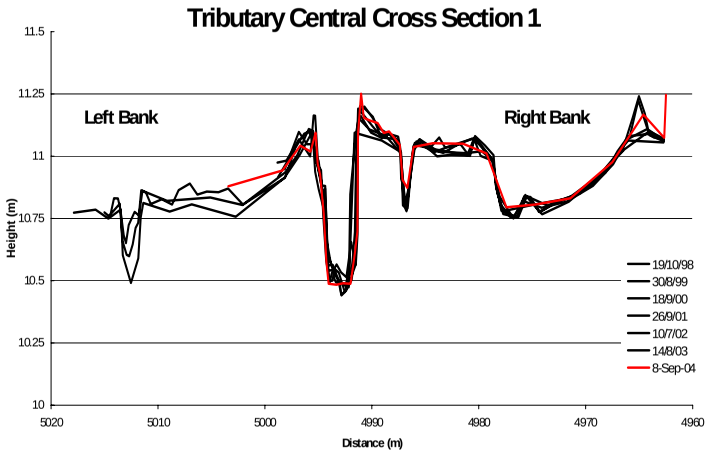

Figure 22 Tributary Central cross section 1

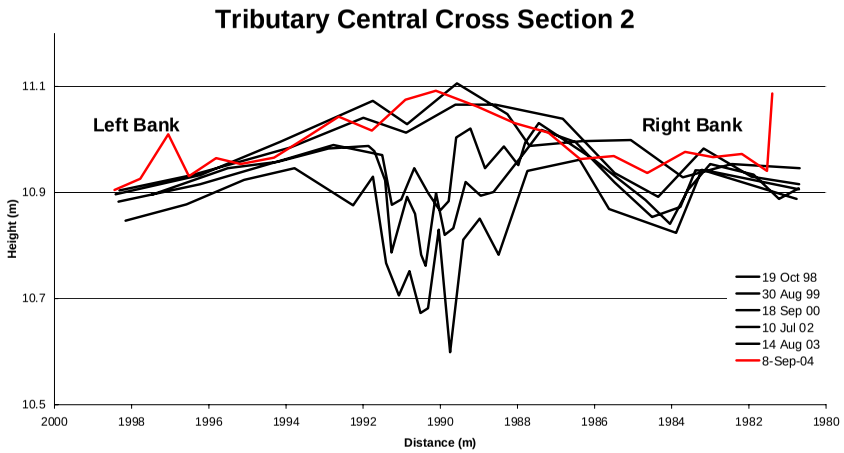

Figure 23 Tributary Central cross section 2

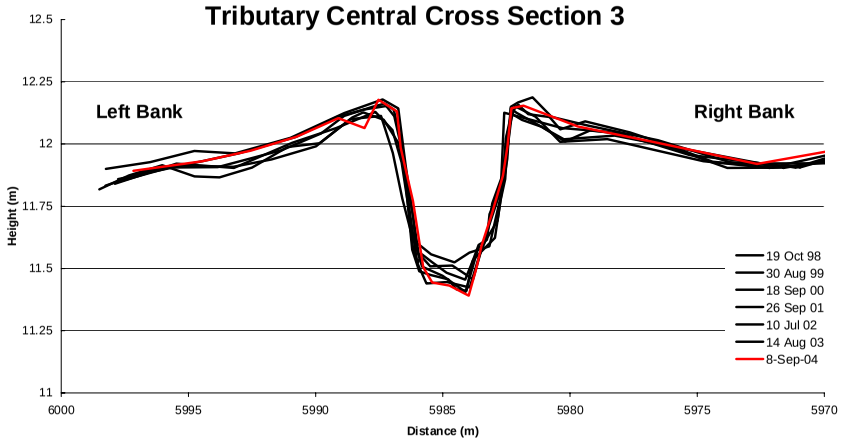

Figure 24 Tributary Central cross section 3

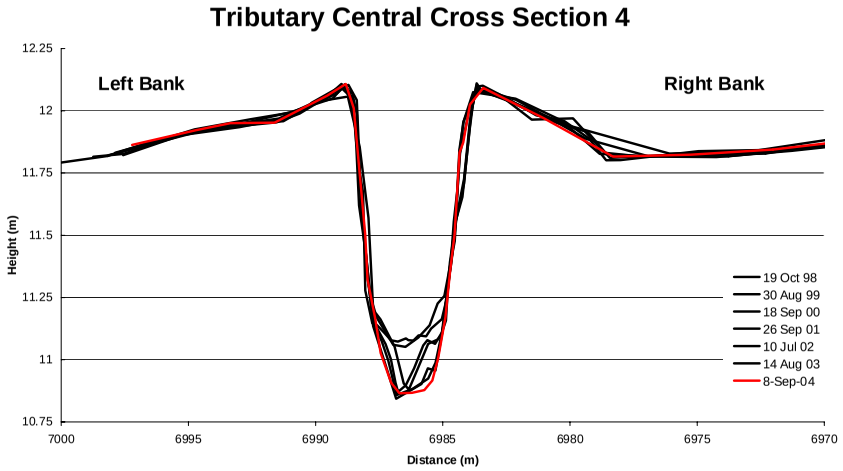

Figure 25 Tributary Central cross section 4

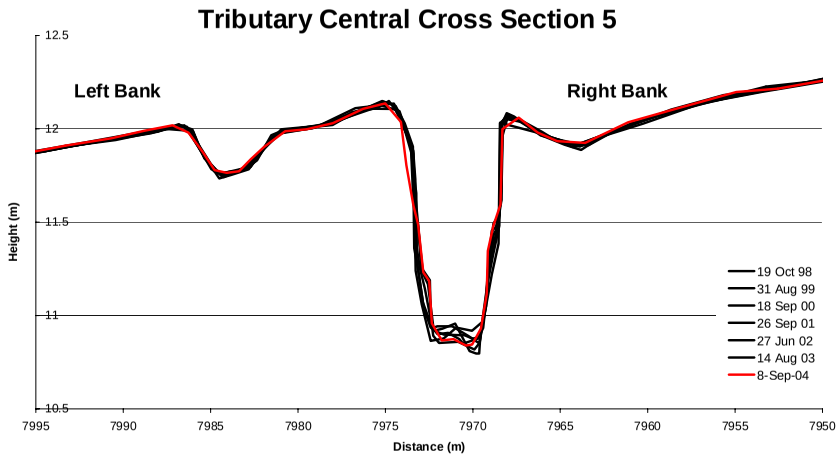

Figure 26 Tributary Central cross section 5

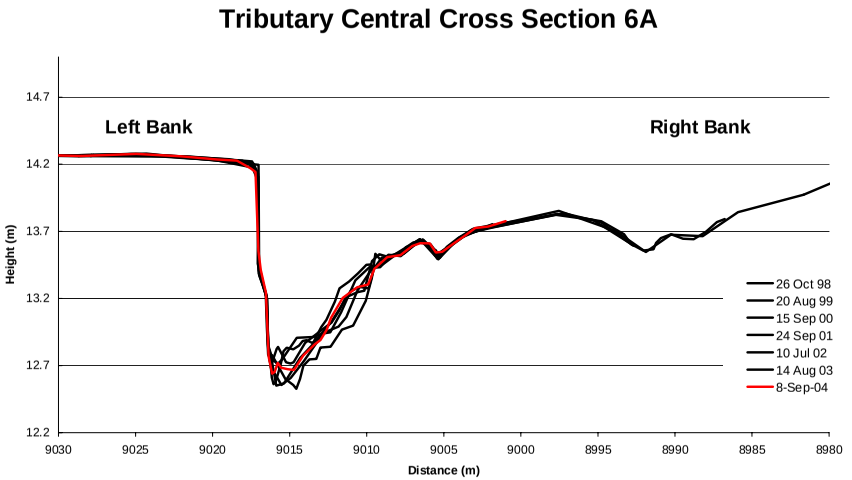

Figure 27 Tributary Central cross section 6A

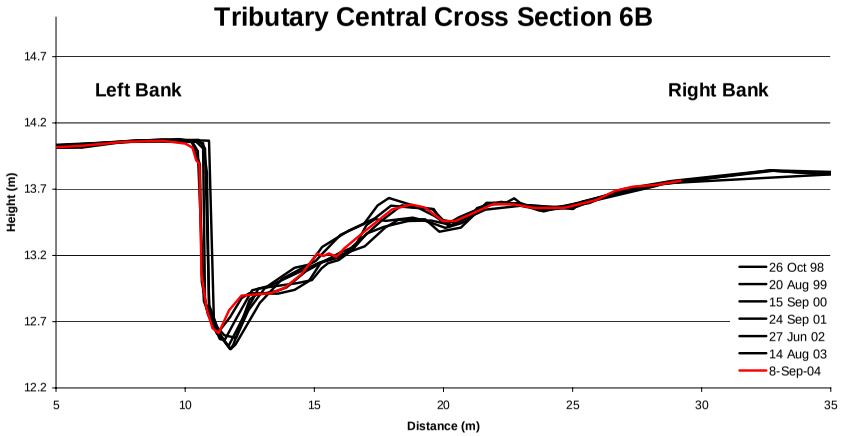

Figure 28 Tributary Central cross section 6B

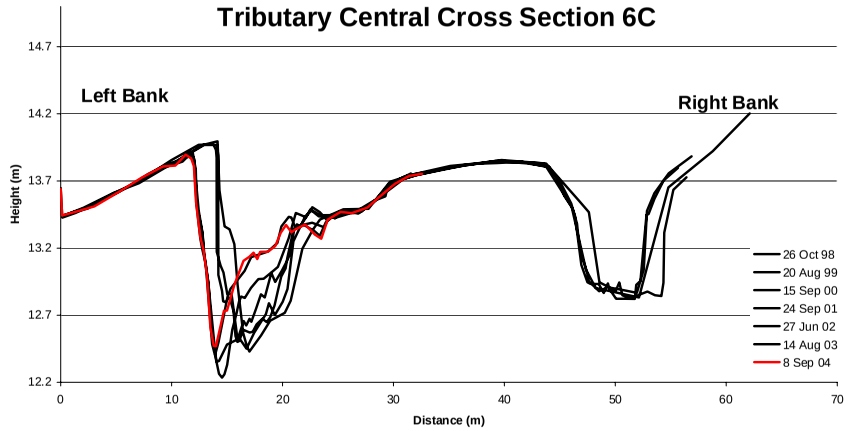

Figure 29 Tributary Central cross section 6C

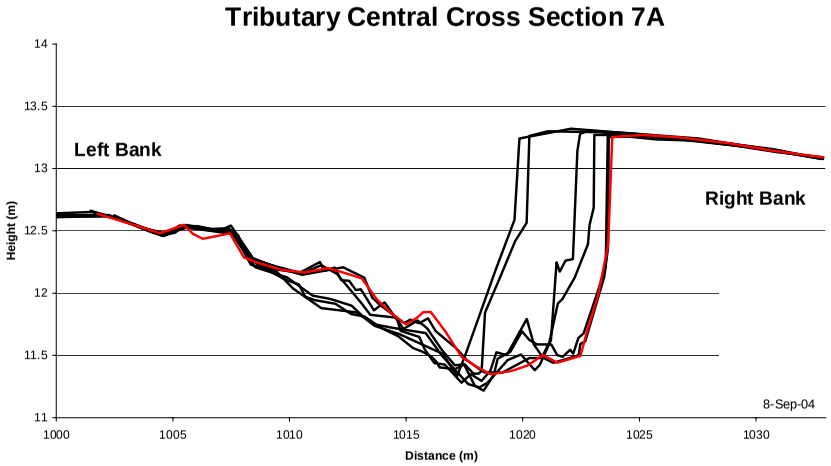

Figure 30 Tributary Central cross section 7A

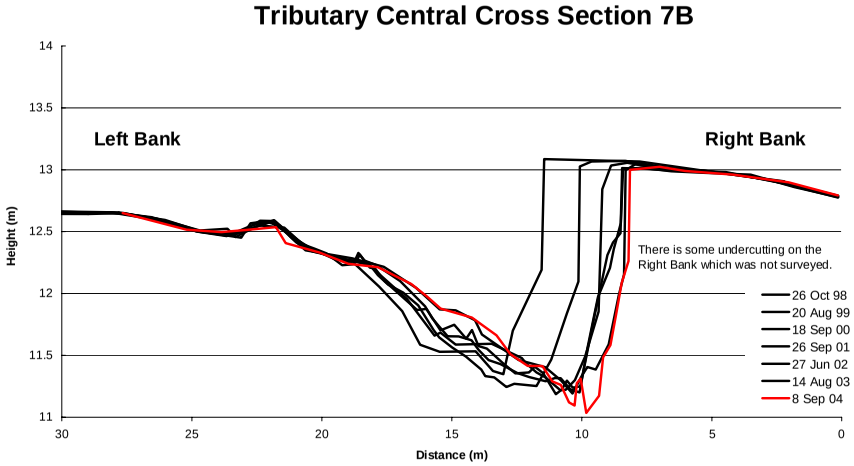

Figure 31 Tributary Central cross section 7B

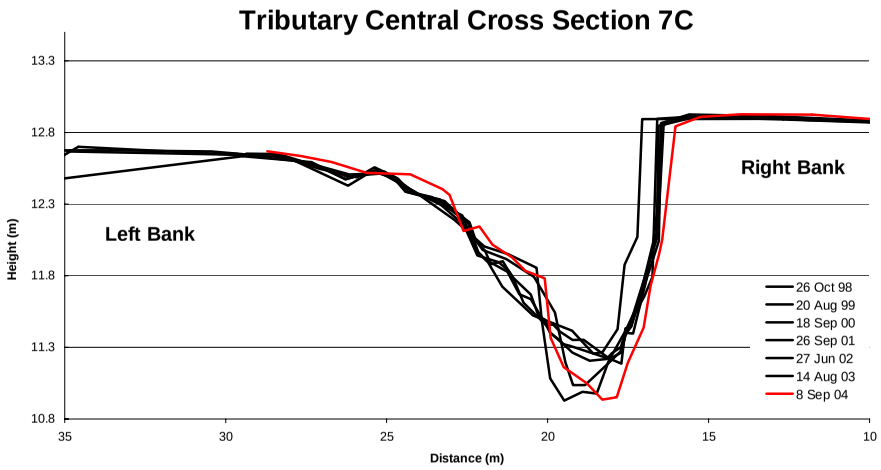

Figure 32 Tributary Central cross section 7C

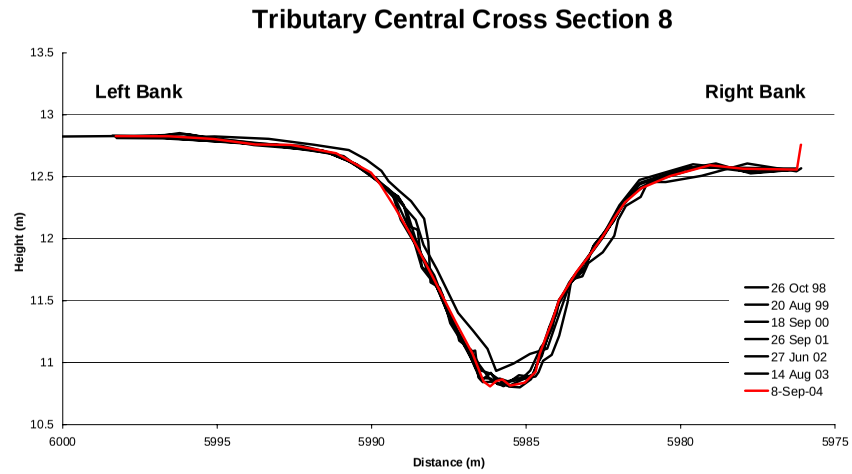

Figure 33 Tributary Central cross section 8

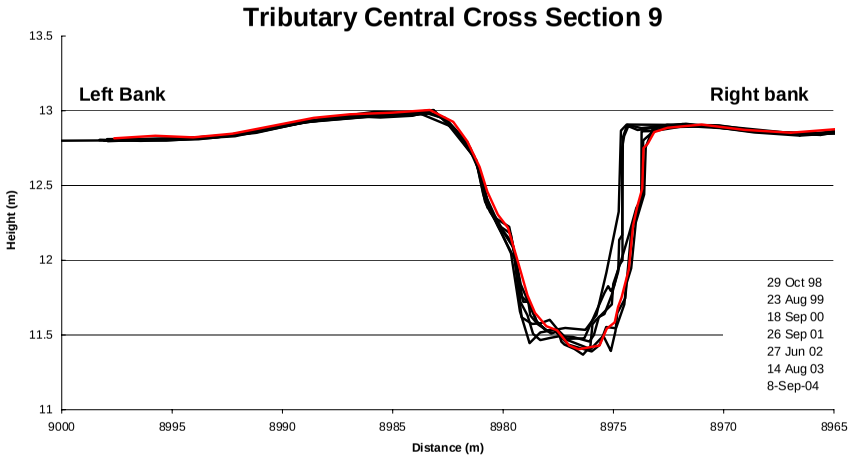

Figure 34 Tributary Central cross section 9

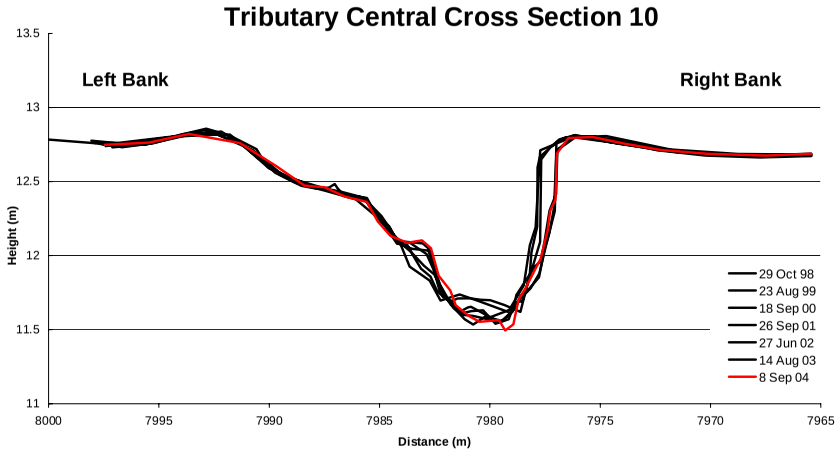

Figure 35 Tributary Central cross section 10

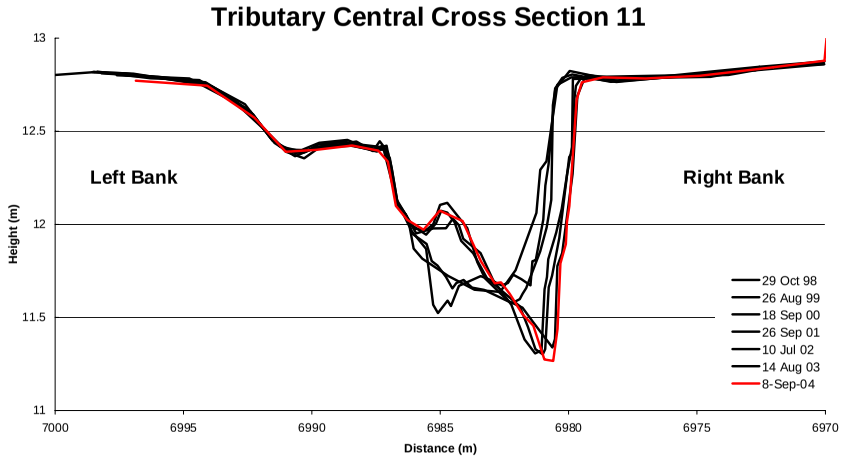

Figure 36 Tributary Central cross section 11

3.3 East Tributary Cross sections

The gauging station is located in a forested meandering reach (Erskine et al 2001). Eight cross sections were installed near the gauge during the 1998 dry season. They have been resurveyed during each subsequent dry season. The locations of the cross sections are shown in figure 37. East Tributary is not impacted by the Jabiluka project and is flanked by a monsoonal vine forest at the gauging station (Erskine et al 2001). The forest stabilises the bank by a high density of tree trunks, roots and root mats. The plots of the cross sections are shown in figures 38 to 45.

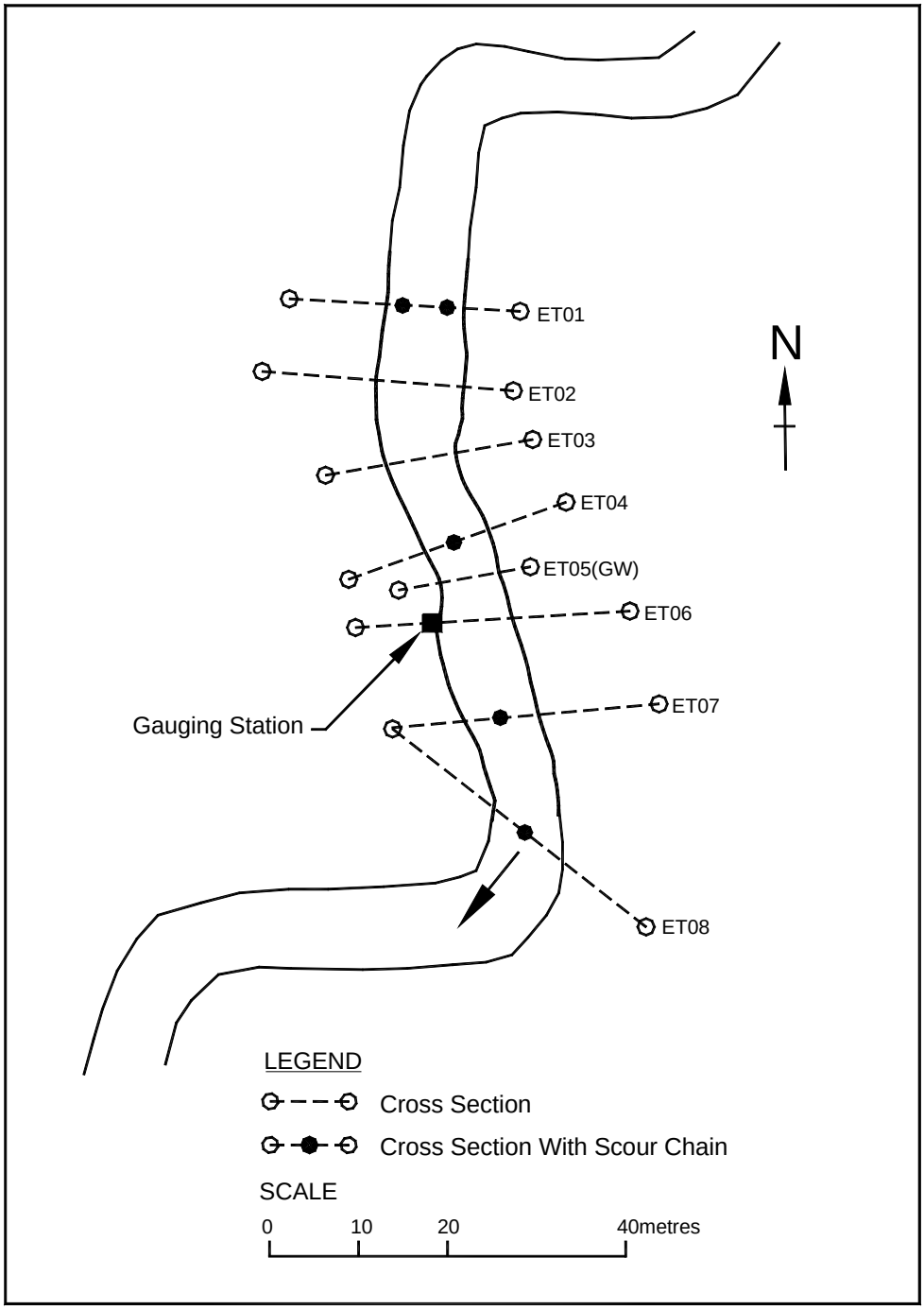

Figure 37 Location of the cross sections on East Tributary at the ***eriss*** gauging station

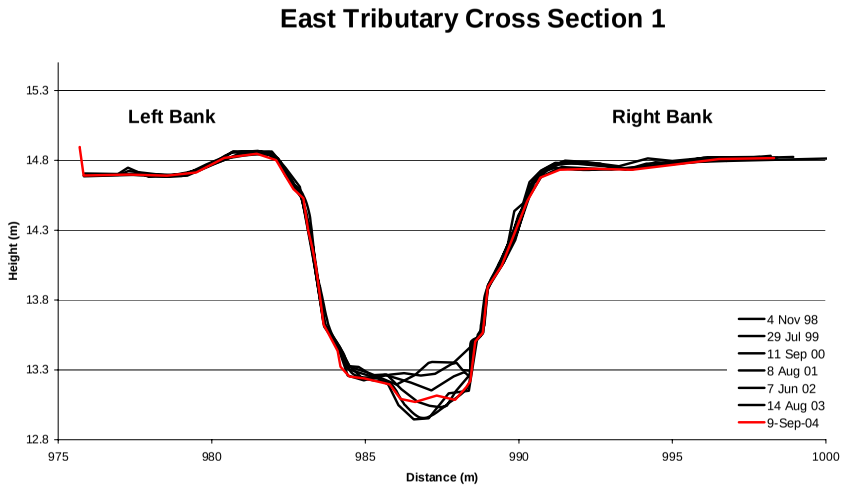

Figure 38 East Tributary cross section 1

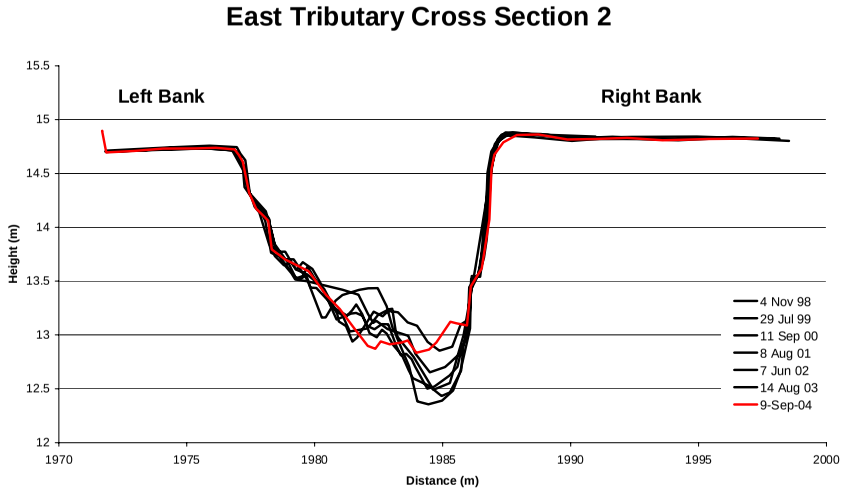

Figure 39 East Tributary cross section 2

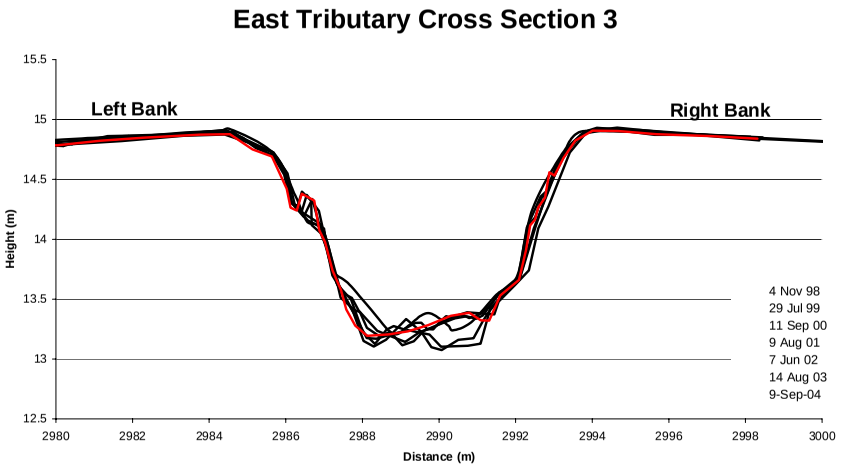

Figure 40 East Tributary cross section 3

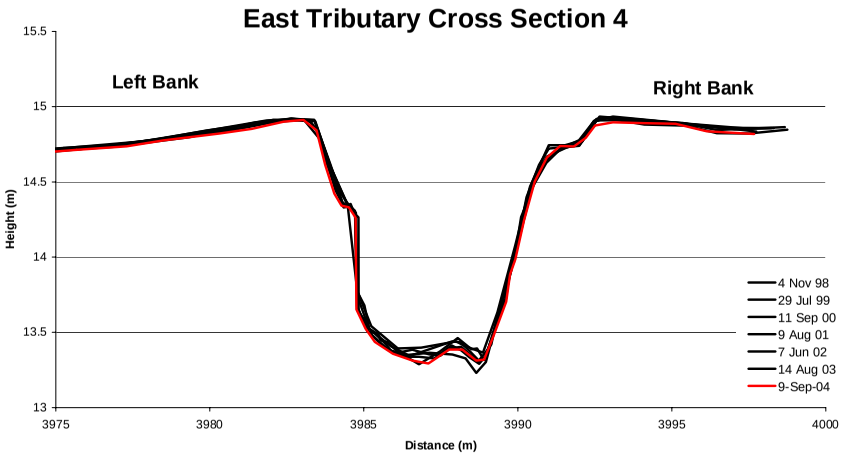

Figure 41 East Tributary cross section 4

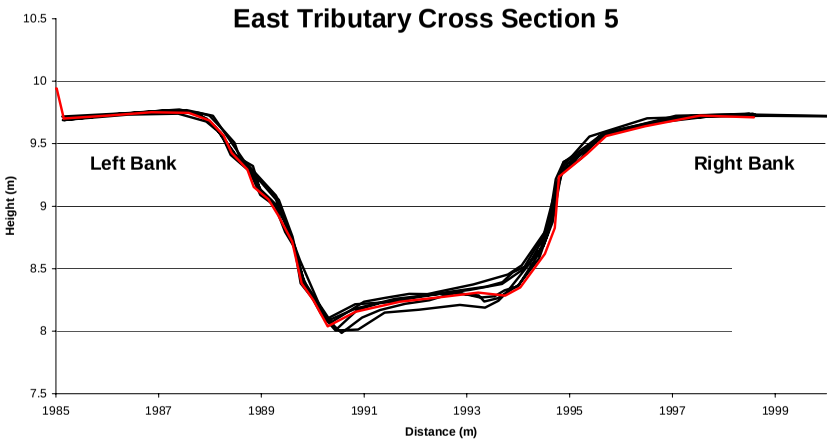

Figure 42 East Tributary cross section 5

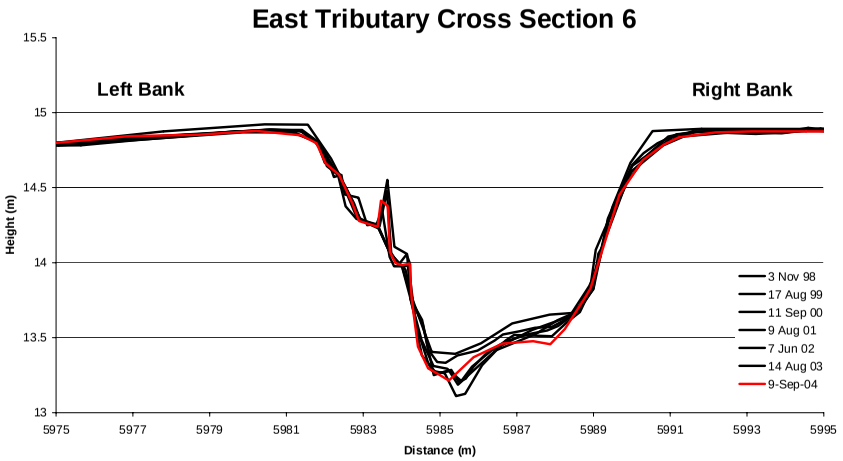

Figure 43 East Tributary cross section 6

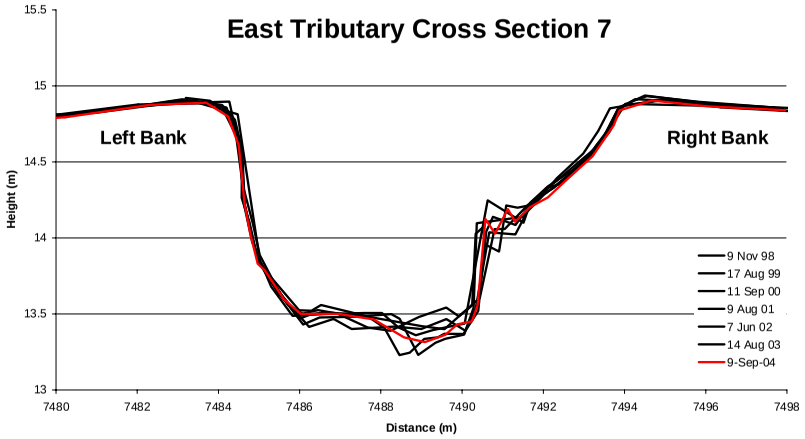

Figure 44 East Tributary cross section 7

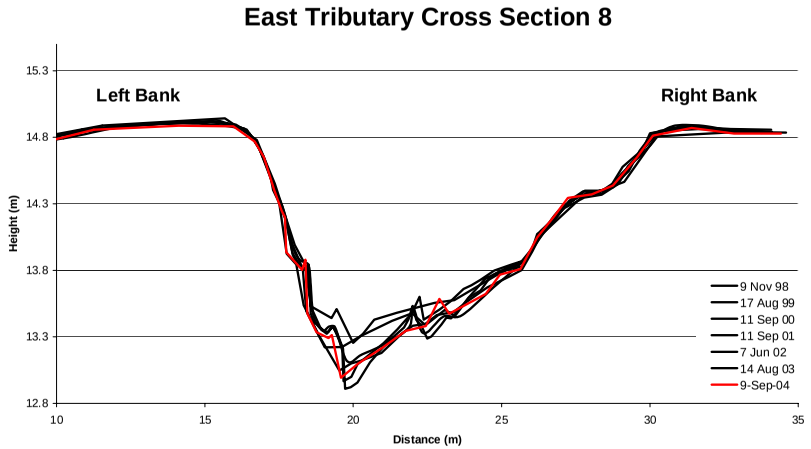

Figure 45 East Tributary cross section 8

3.4 Upper Swift Creek Cross sections

The gauging station is located on upper Ngarradj in a forested meandering reach (Erskine et al 2001). Seven cross sections were installed at the gauge during the 1998 dry season. The locations of the cross sections are shown in figure 46. They were resurveyed during each subsequent dry season. An additional cross section was added in 1999 (the gauging wire). Upper Ngarradj is not impacted by the Jabiluka project and is flanked by a monsoonal vine forest at the gauging station (Erskine et al 2001). Again this forest stabilises the banks. The plots of the cross sections are shown in figures 47 to 54.

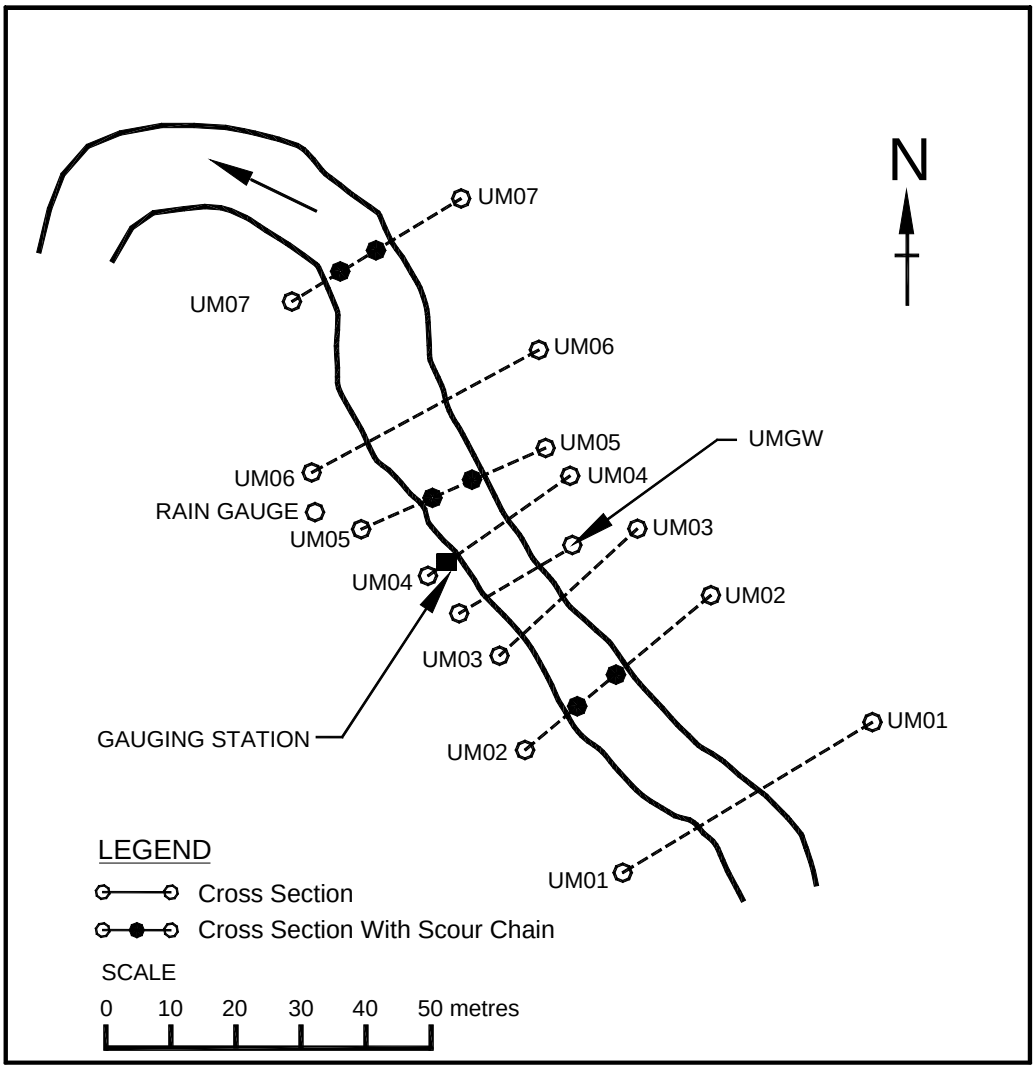

Figure 46 Location of the cross sections at the upper Swift Creek gauge

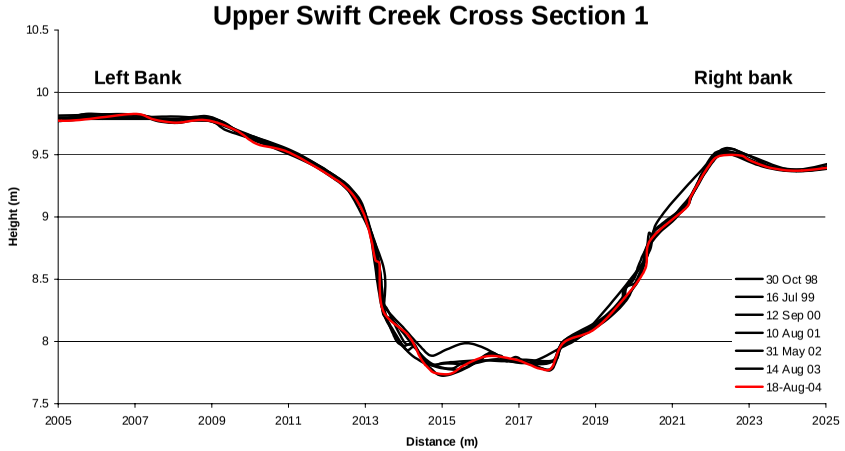

Figure 47 Upper Swift Creek cross section 1

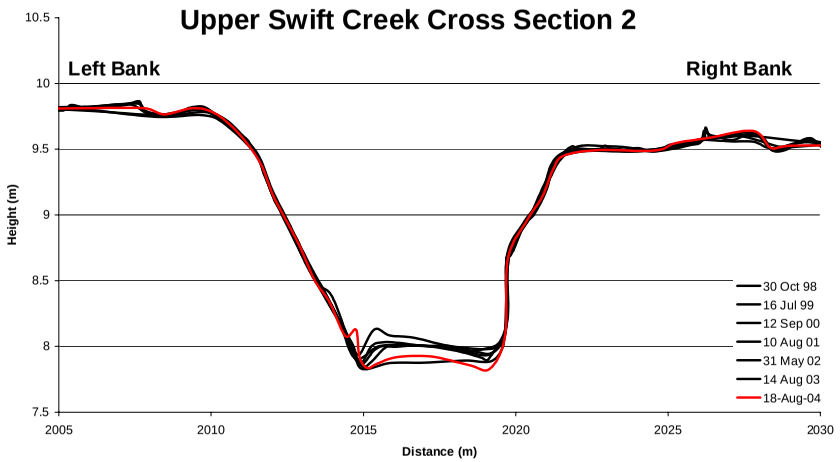

Figure 48 Upper Swift Creek cross section 2

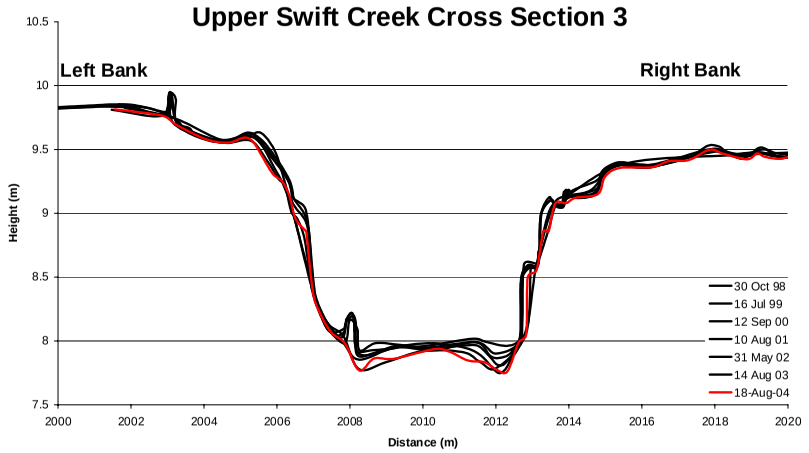

Figure 49 Upper Swift Creek cross section 3

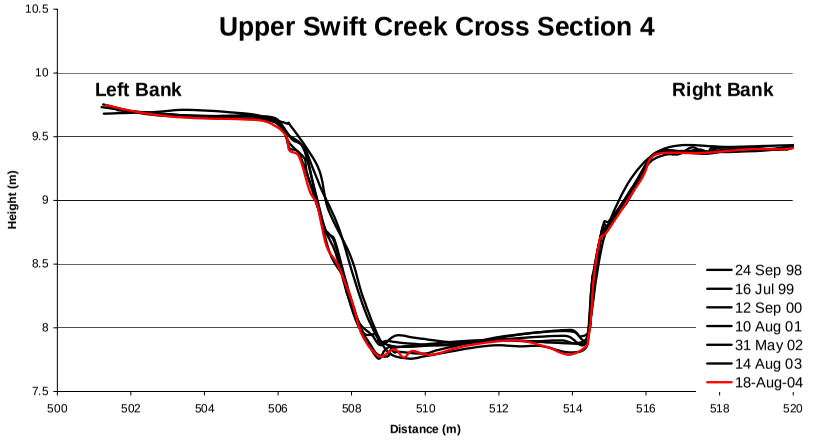

Figure 50 Upper Swift Creek cross section 4

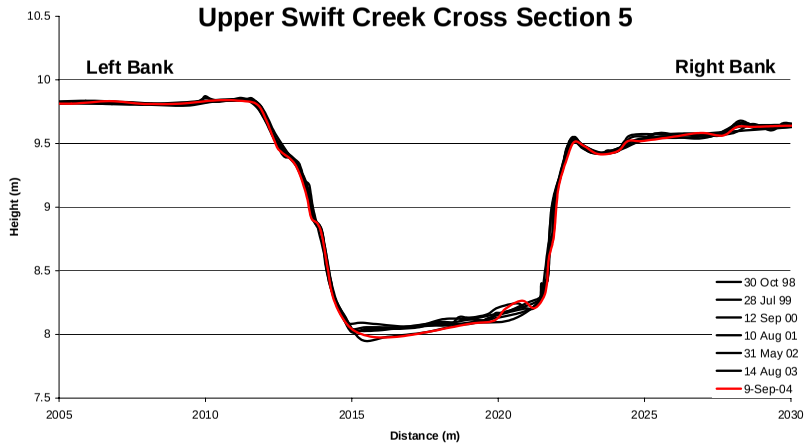

Figure 51 Upper Swift Creek cross section 5

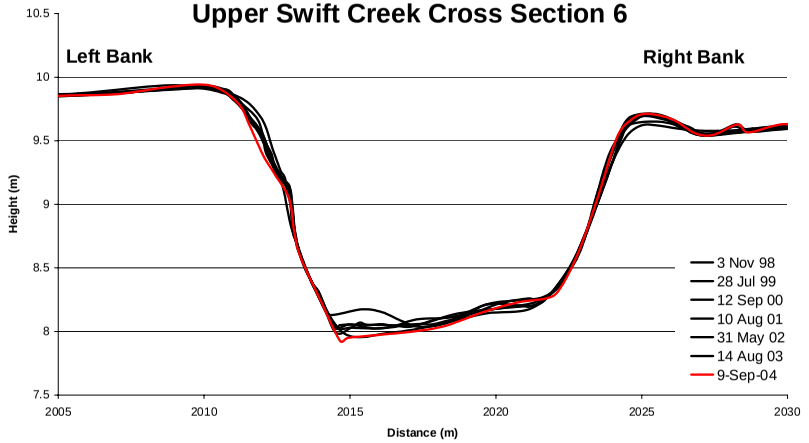

Figure 52 Upper Swift Creek cross section 6

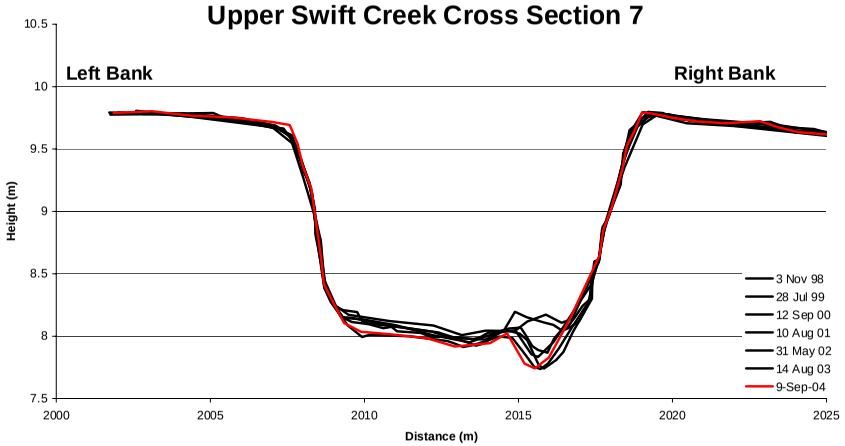

Figure 53 Upper Swift Creek cross section 7

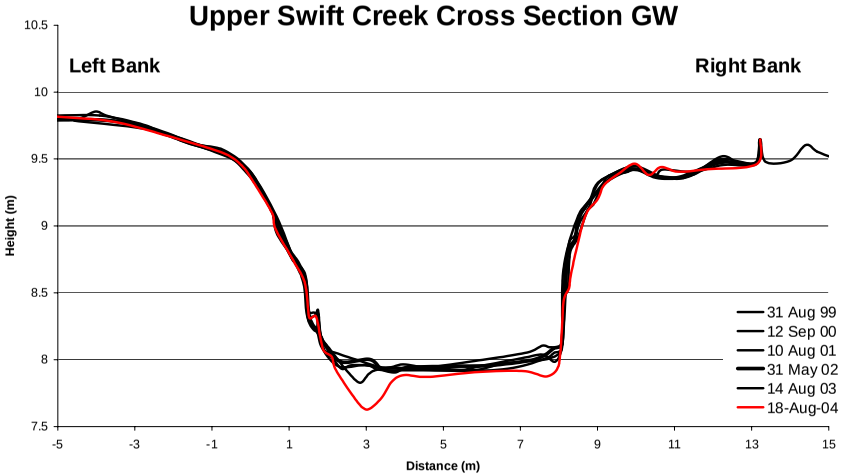

Figure 54 Upper Swift Creek cross section UMGW

3.5 Swift Creek Cross sections

The gauging station is located on Ngarradj in the sinuous reach of Erskine et al (2001). Eight cross sections were installed at the gauge during the 1998 dry season. They were resurveyed during each subsequent dry season. The location of the cross sections is shown in figure 55. It is recommended that monitoring should continue at this site while ever monitoring is being conducted elsewhere in the Ngarradj catchment to provide a comprehensive baseline of information about sediment. The plots of the cross sections are shown in figures 56 to 62.

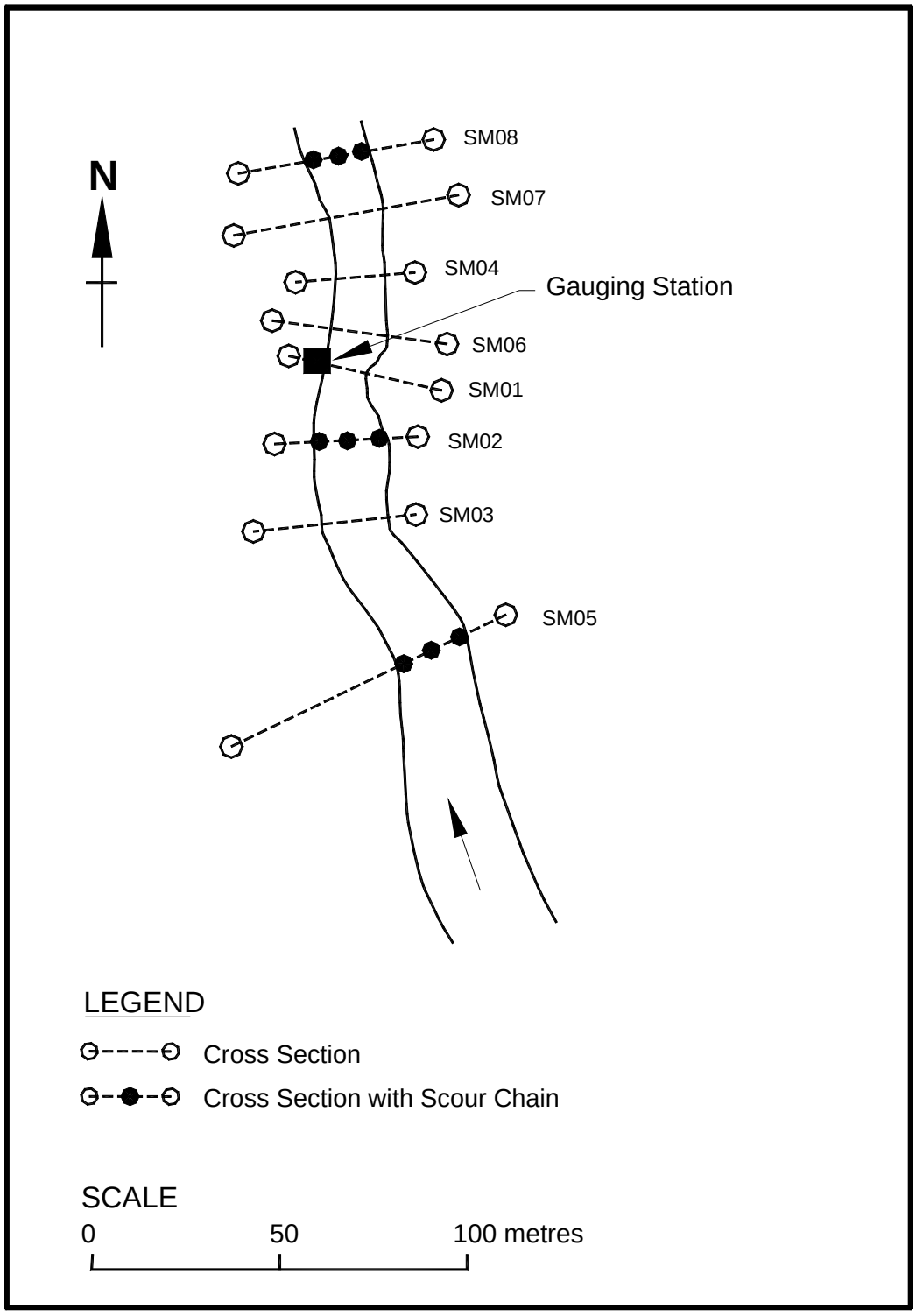

Figure 55 Location of cross sections at the lower Swift Creek gauge

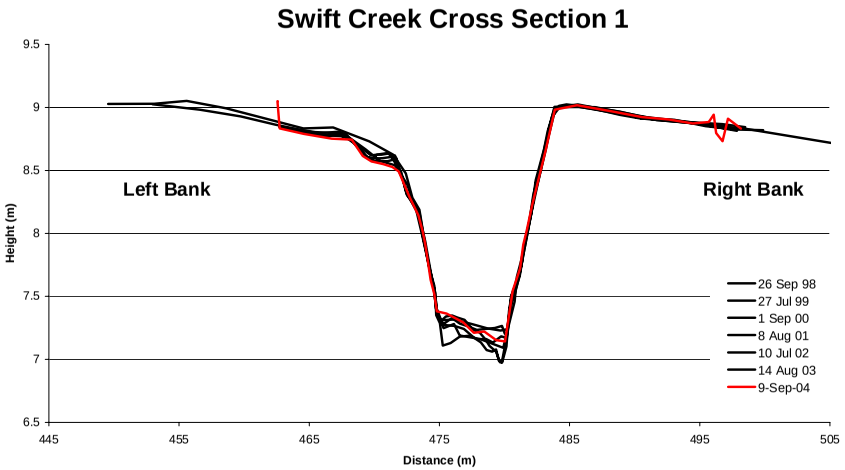

Figure 56 Swift Creek cross section 1

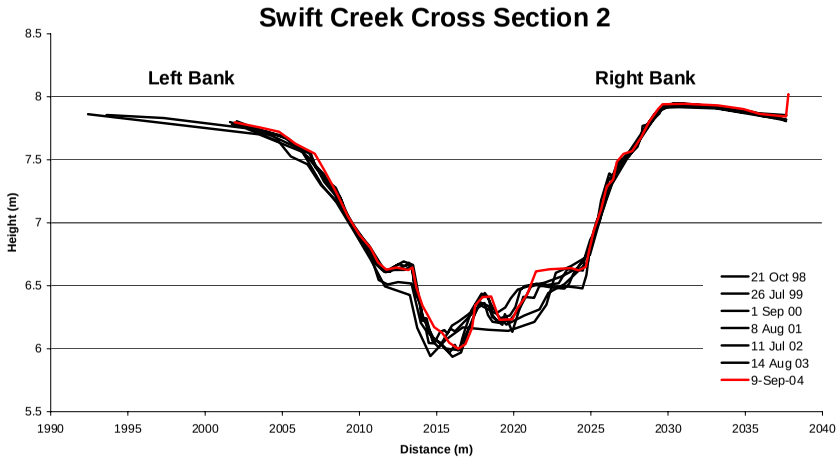

Figure 57 Swift Creek cross section 2

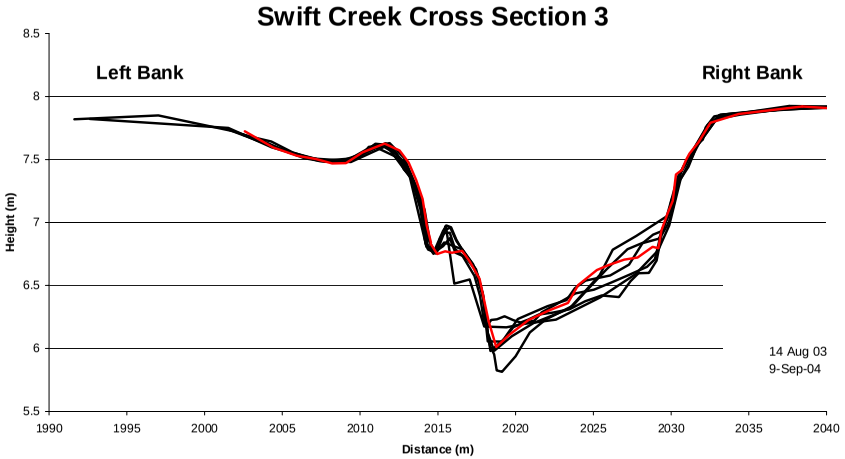

Figure 58 Swift Creek cross section 3

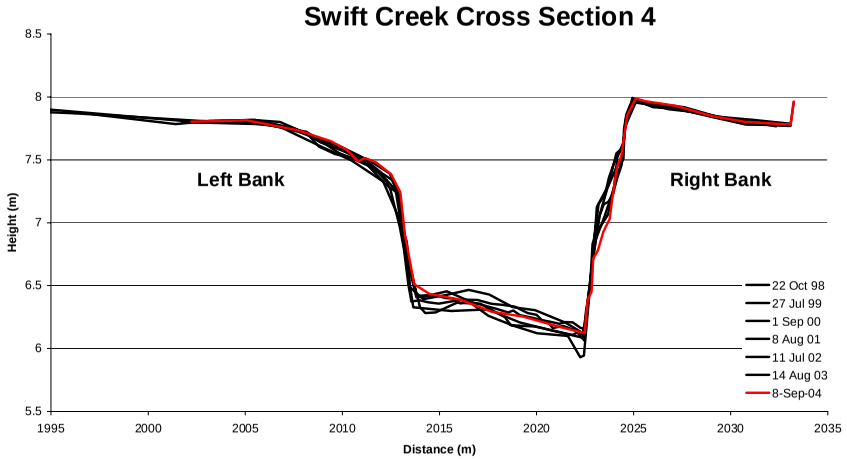

Figure 59 Swift Creek cross section 4

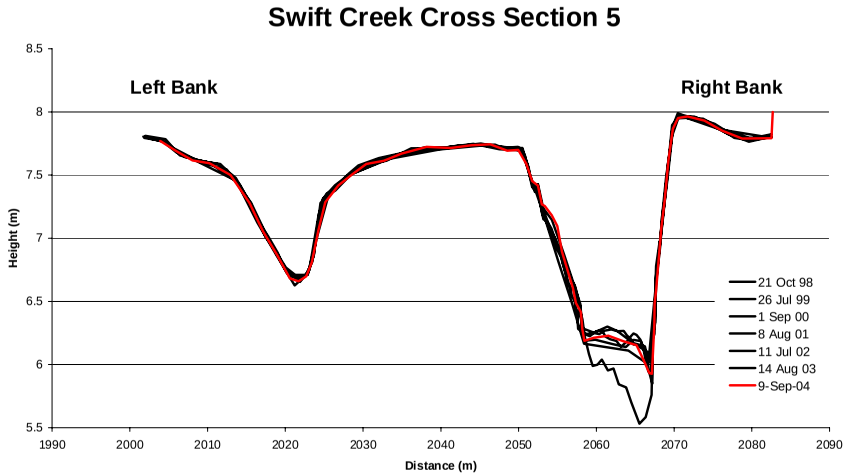

Figure 60 Swift Creek cross section 5

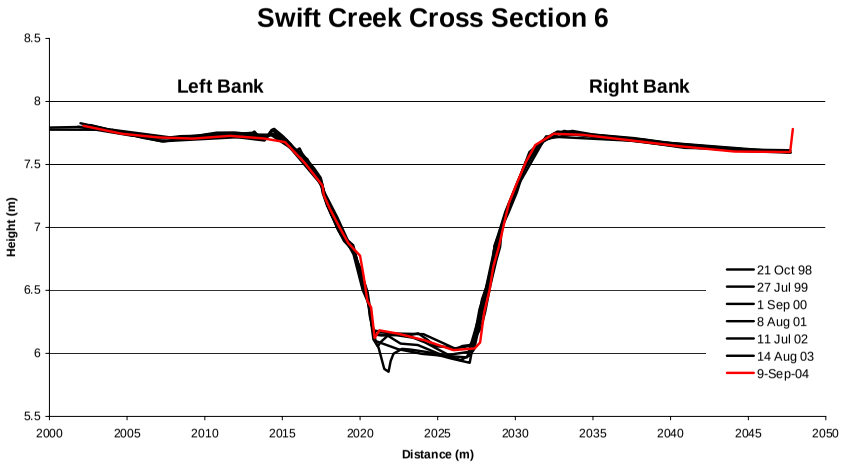

Figure 61 Swift Creek cross section 6

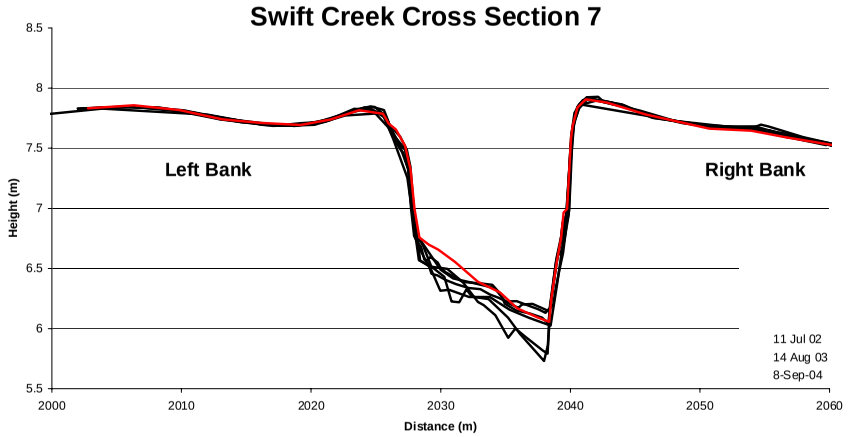

Figure 62 Swift Creek cross section 7

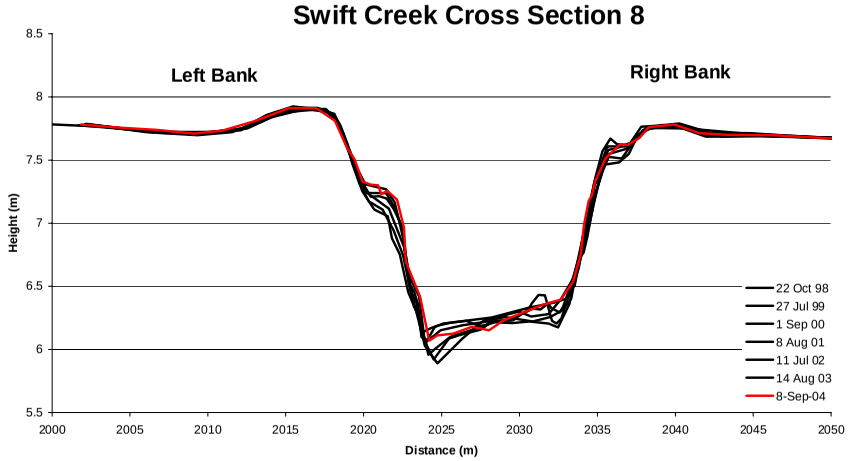

Figure 63 Swift Creek cross section 8

4 Scour Chain Results

Data for 1998/1999, 1999/2000 and 2000/2001 wet seasons are contained in Saynor et al (2002b) and those for 2001/2002 and 2002/2003 in Saynor et al (2004a). Analysis of the scour chain data for the period 1998 to 2003 is contained in Saynor et al (2004c). The data for the 2004 measurements are shown below.

4.1 Tributary North

Chains were installed during the late dry season of 1999 at five cross sections (Fig 64). The following cross sections had a single chain installed in the middle of the main gully: TN02, TN04, and TN07. The most downstream cross section on the main gully, TN09, had two chains installed in the bed. The tributary gully had a single chain installed in the middle of the gully on cross sections TN05 and TN07. The location of all the cross sections are shown in figure 64. The scour chain results are combined for both the main and tributary gullies due to the small sample size.

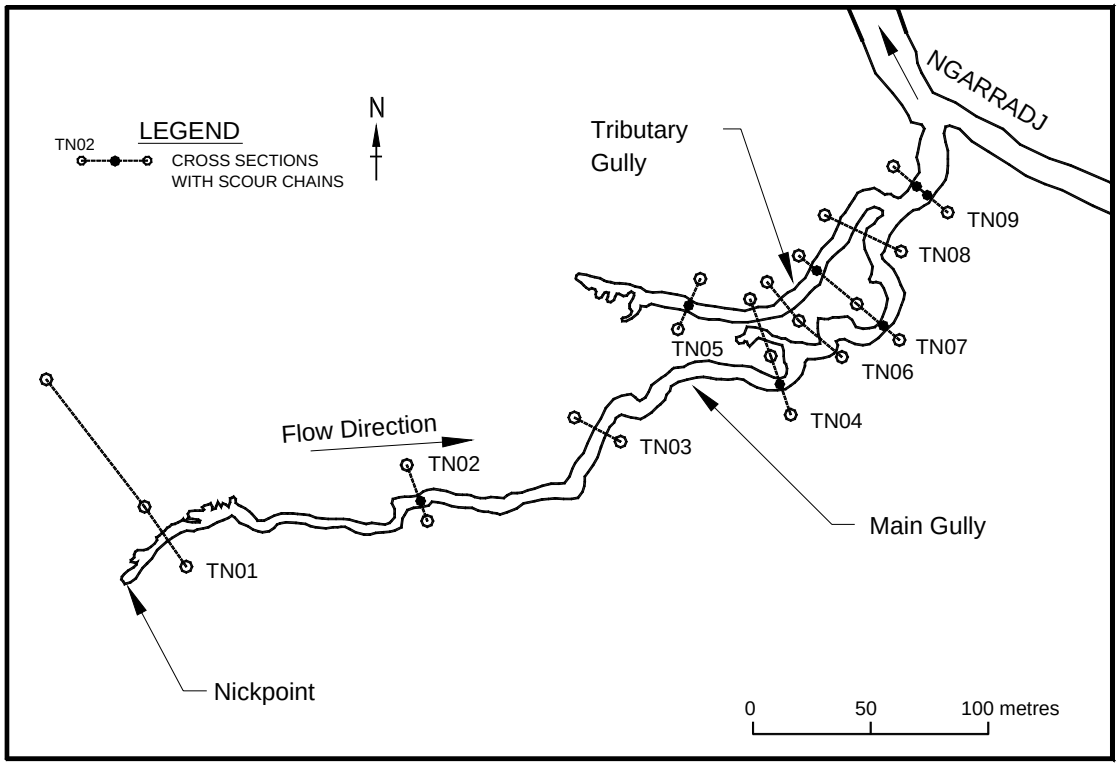

Figure 64 Location of the scour chains in the Gullied Reach of Tributary North

4.1.1 Tributary North cross section 2 (TN02)

There is one chain located in the middle of the gully which was found on 26 October 2004. The chain was buried and was orientated downstream.

- Depth to first link……..220 mm
- Depth to first vertical link…….230 mm
- Depth to straightened chain……...70 mm (2004 bed level)

These measurements show that during the 2003/2004 wet season the bed was scoured to a maximum depth of 160 mm below the 2003 bed level, and then there was subsequent fill of

230 mm which aggraded the bed to its 2004 level. The bed level in 2004 was 70 mm higher than it was in 2003.

4.1.2 Tributary North cross section 4 (TN04)

There was one chain in the middle of the main gully which was found on 26 October 2004. The chain was located with all links vertical. This chain was reset in 2003. This indicates that only fill occurred during the 2003/2004 wet season.

- Depth to first link…… 150 mm
- Depth to first vertical link……150 mm
- Depth to straightened chain…….150 mm (2003 bed level)

These measurements show that during the 2003/2004 wet season the bed was not scoured. There was only aggradation and the 2004 bed level was 150 mm higher than the 2003 level.

4.1.3 Tributary North cross section 5 (TN05)

Tributary North cross section 5 (TN05) is located on the tributary gully channel and has one chain located in the middle of the gully. This chain was located on 26 October 2004. All links were vertical. This chain was not reset in 2003 and was left 36 mm below the bed level.

- Depth to first link……..40 mm
- Depth to first vertical link…….40 mm
- Depth to straightened chain……..40 mm
  (This chain was not reset but left 36 mm below 2003 bed level)

These measurements show that during the 2003/2004 wet season there was no scour and when taking into account the fact that the chain was not reset in 2003 (chain already buried by 36 mm) there was only 4 mm of bed aggradation. The bed level in 2004 was 4 mm higher than in 2003.

4.1.4 Tributary North cross section 7 (TN07)

Cross section 7 is located across both the main channel and the tributary gully (fig 64). A single scour chain was installed in each gully.

4.1.4.1 Tributary North Cross Section 7, (TN07- main gully)

This chain was located in the middle of the bed and was found on 26 October 2004.

- Depth to first link…….50 mm
- Depth to first vertical link……50 mm
- Depth to straightened chain…….50 mm
  (This chain was not reset but left 76mm below 2003 bed level)

These measurements show that during the 2003/2004 wet season there was no scour and when taking into account the fact that the chain was not reset in 2003 (chain already buried by 76 mm) there was 26 mm of bed aggradation. The bed level in 2004 was 26 mm higher than the 2003 bed level.

4.1.4.2 Tributary North Cross Section 7, (TN07- tributary)

This chain was located in the middle of the tributary gully and was found on 26 October 2004. The top links of the chain were horizontal and orientated downstream indicating that there was some scour.

- Depth to first link……65 mm

- Depth to first vertical link……...85 mm
- Depth to straightened chain……10 mm (2003 bed level)

These measurements show that during the 2003/2004 wet season the bed was scoured to a depth of 75mm and then had 85mm of fill, which aggraded the bed to 10 mm above the 2003 level.

4.1.5 Tributary North cross section 9 (TN09)

This cross section is located on the main gully downstream of the confluence with the left bank tributary gully but upstream of the junction with Ngarradj (fig 64).

4.1.5.1 Scour Chain 1, (TN09-1)

Scour Chain 1 is located towards the left bank and was found on 26 October 2004. The chain was found with all links vertical.

- Depth to first link……40 mm
- Depth to first vertical link……...40 mm
- Depth to straightened chain…….40 mm (2003 bed level)

These measurements show that during the 2003/2004 wet season the bed was not scoured but there was 40 mm of deposition making the bed level 40 mm higher than the 2003 bed level.

4.1.5.2 Scour Chain 2, (TN09-2)

Scour Chain 2 is located towards the right bank of cross section 9 and was found on 26 October 2004. The chain was found with all links vertical.

- Depth to first link…….58 mm
- Depth to first vertical link……..…58 mm
- Depth to straightened chain……..58 mm (2001 bed level)

These measurements show that during the 2003/2004 wet season the bed was not scoured but there was 58 mm of deposition. The 2004 bed level was 58 mm higher than the 2003 bed level.

At TN09 there was no scour during the 2003/2004 wet season, however there was an average fill of 49 mm. These results suggest that there was not much activity at this section because the cross section was backwater affected at high flows.

4.2 Tributary Central

A single chain was located on each of three cross sections, TC09, TC11 and TC03 before the 1988/1999 wet season (fig 21). The scour chain results are presented below

4.2.1 Tributary Central cross section 9 (TC09)

There is one chain located in the middle of the channel which was found on 26 October 2004. The chain was found undisturbed with all links vertical.

- Depth to first link……0 mm
- Depth to first vertical link……0 mm
- Depth to straightened chain…….0 mm (2003 bed level)

These measurements show that during the 2003/2004 wet season the bed was not scoured at all. The bed level in 2004 was the same as in 2003.

4.2.2 Tributary Central cross section 11 (TC11)

There is one chain located in the middle of the channel which was found on 26 October 2004. There is a gravel armoured sand bar at this location. This chain is no longer in the middle of the bed due to lateral migration of the creek bed.

- Depth to first link……..…..25 mm
- Depth to first vertical link……..….25 mm
- Depth to straightened chain.……..25 mm (2003 bed level)

These measurements show that during the 2003/2004 wet season the bed was not scoured but there was 25mm of deposition. The bed level in 2004 was 25 mm above the 2003 bed level.

4.2.3 Tributary Central cross section 3 (TC03)

There is one chain located in the middle of the channel which was found on 26 October 2004. The links were lying upstream and orientated towards the left bank.

- Depth to first link…….65 mm
- Depth to first vertical link……105 mm
- Depth to straightened chain…….-80mm (2003 bed level)

These measurements show that during the 2003/2004 wet season the bed was scoured to a maximum depth of 185 mm below the 2003 bed level, and then there was subsequent fill of 105 mm. The 2004 bed level was 80 mm lower than the 2003 bed level. This chain was not reset and 2 links (50-60 mm) were left above the bed.

4.3 East Tributary scour chains

Scour chains were installed at four cross sections at the East Tributary gauging station before the 1998/99 wet season. Two chains were located on cross section ET01 and one chain was located on ET04, ET07 and ET08 (fig 37).

4.3.1 East Tributary cross section 1 (ET01)

4.3.1.1 Chain 1 (ET01-1)

Scour chain 1 is located towards the left bank and was found on 26 October 2004. The chain was orientated diagonally downstream and towards the right bank.

- Depth to first link …….…...140 mm
- Depth to first vertical link……202 mm
- Depth to straightened chain……..28 mm (2003 bed level)

These measurements show that during the 2003/2004 wet season the bed was scoured to a maximum depth of 174 mm below the 2003 bed level, and then there was subsequent fill of 202 mm. The 2004 bed level was 28 mm higher than the 2003 bed level.

4.3.2 Chain 2 (ET01-2)

This chain was found on 26 October 2004. The chain was buried and was orientated downstream towards the left bank. This chain could not be reset in 2003 and was left 240 mm below bed level.

- Depth to first link …….…..240 mm
- Depth to first vertical link……260 mm
- Depth to straightened chain……100 mm (2003 bed level)

These measurements show that during the 2003/2004 wet season there was 20 mm of scour and when taking into account the fact that the chain was not reset in 2003 (chain already buried by 240 mm) there was 160 mm of bed aggradation. The bed level in 2004 was 140 mm higher than the 2003 bed level.

For East Tributary Cross Section 1, the 2003/2004 wet season average scour was 97 mm and the average fill was 181 mm.

4.3.3 East Tributary cross section 4 (ET04)

There is one chain in the middle of the channel which was located on 26 October 2004. The chain was orientated towards the right bank, then a downstream direction. This chain could not be reset in 2003 and was left 55 mm above the bed level.

- Depth to first link …….…….52 mm
- Depth to first vertical link.…….70 mm
- Depth to straightened chain……-60 mm
  (This chain was not reset but left 55 mm above 2003 bed level)

The measurements show that during the 2003/2004 wet season the bed was scoured to a maximum depth of 75 mm and then there was subsequent fill of 70 mm. The bed level in 2004 was 5 mm lower than the 2003 bed level. This chain was not reset in 2004 and was left 60 mm (2 links) above bed level.

4.3.4 East Tributary cross section 7 (ET07)

There is one chain located in the middle of the channel which was located on 26 October 2004. It was orientated towards the left bank but angled downstream.

- Depth to first link …….……405 mm
- Depth to first vertical link…….360 mm
- Depth to straightened chain……..25 mm (2003 bed level)

These measurements show that during the 2003/2004 wet season the bed was scoured to a maximum depth of 380 mm and then there was subsequent fill of 405 mm. The 2004 bed level was 25 mm higher than the 2003 bed level.

4.3.5 East Tributary cross section 8 (ET08)

There is one chain located near the thalweg on the outside of the point bar towards the left bank. The chain was located on 26 October 2004 and was orientated towards left bank and downstream.

- Depth to first link …….……60 mm
- Depth to first vertical link…….76 mm
- Depth to straightened chain…….-120 mm (2003 bed level)

These measurements show that during the 2003/2004 wet season the bed was scoured to a maximum depth of 196 mm below the 2003 bed level, and then there was subsequent fill of 76 mm. The bed level in 2004 was 120 mm lower than the 2003 bed level. This chain could not be reset to bed level and was left 120 mm (4 links) above 2004 bed.

4.4 Upper Swift Creek scour chains

Scour chains were installed at three cross sections at the Upper Swift Creek gauging station before the 1998/99 wet season. Two chains were located at cross sections UM02, UM05 and UM07. The location of the cross sections is shown in figure 46.

4.4.1 Upper Swift Creek cross section 2 (UM02)

Chain 1 was located closer to the left bank and chain 2, closer to the right bank.

4.4.1.1 Chain 1 (UM02-1)

This chain was located on 26 October 2004 and was orientated towards the right bank and downstream.

- Depth to first link…….130 mm
- Depth to first vertical link……180 mm
- Depth to straightened chain…….-110mm (2003 bed level)

These measurements show that during the 2003/2004 wet season the bed was scoured to a maximum depth of 290 mm and then there was subsequent fill of 180 mm. The 2004 bed level was 110 mm below the 2003 level. This chain could not be reset in 2004 and was left 110 mm (4 links) above the bed.

4.4.1.2 Chain 2 (UM02-2)

This chain was located on 26 October 2004 and was orientated towards the left bank and slightly upstream.

- Depth to first link……..…195 mm
- Depth to first vertical link……206 mm
- Depth to straightened chain……..…-85 mm (2003 bed level)

These measurements indicate that during the 2003/2004 wet season the bed was scoured to a maximum depth of 291 mm and then there was subsequent fill of 206 mm. The 2004 bed level was 85 mm below the 2003 level. This chain was not reset in 2004 and was left 85 mm (3 links) above the bed.

For the 2003/2004 wet season at Upper Swift Creek cross section 2, the average scour was 290.5 mm and the average fill was 193 mm.

4.4.2 Upper Swift Creek cross section 5 (UM05)

Chain 1 was located closer to the left bank and chain 2, closer to the right bank.

4.4.2.1 Chain 1 (UM05-1)

This chain was located on 26 October 2004 and was orientated towards the right bank.

- Depth to first link…….81 mm
- Depth to first vertical link……107 mm
- Depth to straightened chain……-60 mm (2003 bed level)

These measurements show that during the 2003/2004 wet season the bed was scoured to a maximum depth of 167 mm and then there was subsequent fill of 107 mm. The 2004 bed level was 60 mm higher than the 2003 bed level. This chain was not reset in 2004 and was left 60 mm (2 links) above the bed.

4.4.2.2 Chain 2 (UM05-2)

This chain was located on 26 October 2004 with several links in a pile on top of each other.

- Depth to first link…….68 mm
- Depth to first vertical link……80 mm
- Depth to straightened chain…….-32 mm (2003 bed level)

These measurements show that during the 2003/2004 wet season the bed was scoured to a maximum depth of 112 mm and then there was subsequent fill of 80 mm. The 2004 bed level was 32 mm lower than the 2003 bed level. This chain was not reset in 2004 leaving one link above the bed level.

For Upper Swift Creek cross section 5, the 2003/2004 wet season average scour was 143 mm and the average fill was 93.5 mm.

4.4.3 Upper Swift Creek cross section 7 (UM07)

Chain 1 was located closer to the left bank and chain 2, closer to the right bank.

4.4.3.1 Chain 1 (UM07-1)

This chain was located on 26 October 2004 and was orientated towards the right bank and slightly downstream.

- Depth to first link…….130 mm
- Depth to first vertical link……163 mm
- Depth to straightened chain…….-95 mm (2003 bed level)

These measurements show that during the 2003/2004 wet season the bed was scoured to a maximum depth of 258 mm and then there was fill of 163mm. The 2004 bed level was 95 mm below the 2003 bed level. This chain was not reset in 2004 and was left 95 mm (3 links) above bed level.

4.4.3.2 Chain 2 (UM07-2)

This chain was located on 26 October 2004, and was orientated diagonally upstream towards the left bank.

- Depth to first link……..175 mm
- Depth to first vertical link…….160 mm
- Depth to straightened chain…….-35 mm (2003 bed level)

These measurements show that during the 2003/2004 wet season the bed was scoured to a maximum depth of 210 mm and then there was subsequent fill of 175 mm. The 2004 bed level was 35 mm below the 2003 bed. This chain was not reset in 2004 and was left 35 mm (1 link) above the bed.

For Upper Swift Creek cross section 7, the 2003/2004 wet season average scour was 248 mm and the average fill was 283 mm.

4.5 Swift Creek scour chains

Scour chains were installed at two cross sections at the Swift Creek gauging station before the 1998/99 wet season. Three chains were located at cross sections SM05 and SM08. Additional chains were installed at cross section SM02 before the 1999/2000 wet season. The location of the cross sections is shown in figure 55.

4.5.1 Swift Creek cross section 5 (SM05)

The three chains at cross section 5 were searched for on 18 September 2002. The water table was reached at a depth of 200 mm below the surface and one of the chains (SM05-1) could be felt by hand at a depth of approximately 500 mm. It was not possible to make any measurements at any of the scour chains. The chains were not reset and thus there were similar problems when the chains were searched for on 12 November 2003 and 26 October 2004. Therefore, no scour and fill data were obtained at this section for the 2001/2002, 2002/2003 and 2003/2004 wet seasons at this cross section.

4.5.2 Swift Creek cross section 2 (SM02)

4.5.2.1 Chain 1 SM02-1

This chain was located on 26 October 2004 and was orientated downstream.

- Depth to first link…….45 mm
- Depth to first vertical link……53 mm
- Depth to straightened chain……..…0 mm (2003 bed level)

These measurements show that during the 2003/2004 wet season the bed was scoured to a maximum depth of 53 mm and then there was subsequent fill of 53 mm. The 2004 bed level was the same as the 2003 bed level.

4.5.2.2 Chain 2 (SM02-2)

This chain was located on 26 October 2004 and was orientated slightly towards the left bank and downstream

- Depth to first link……133 mm
- Depth to first vertical link……...138 mm
- Depth to straightened chain….……33 mm (2003 bed level)

These measurements show that during the 2003/2004 wet season the bed was scoured to a maximum depth of 105 mm and then there was subsequent fill of 138 mm. The 2004 bed level was 33 mm higher than the 2003 bed level.

4.5.2.3 Chain 3 (SM02-3)

This chain was located on 26 October 2004 and all links were vertical.

- Depth to first link……..….283 mm
- Depth to first vertical link…….283 mm
- Depth to straightened chain……..283 mm (2003 bed level).

These measurements suggest that during the 2003/2004 wet season the bed was not scoured at all and 283 mm of deposition occurred.

For the 2003/2004 wet season, the average scour was 53 mm and the average fill was 158 mm.

4.5.3 Swift Creek cross section 8 (SM08)

4.5.3.1 Chain 1 (SM08-1)

This chain was located on 26 October 2004 and was orientated slightly upstream and towards the right bank.

- Depth to first link……...350 mm

- Depth to first vertical link……..397 mm
- Depth to straightened chain……...185 mm (2003 bed level)

These measurements show that during the 2003/2004 wet season the bed was scoured to a maximum depth of 212 mm below 2003 bed level and then there was subsequent fill of 397 mm. The 2004 bed level was 185 mm higher than the 2003 bed level.

4.5.3.2 Chain 2 (SM08-2)

This chain was located on 26 October 2004 and was orientated initially circularly towards the left bank and the diagonally downstream towards the right bank.

- Depth to first link…….340 mm
- Depth to first vertical link…….380 mm
- Depth to straightened chain…….10 mm (2003 bed level)

These measurements show that during the 2003/2004 wet season the bed was scoured to a maximum depth of 370 mm and then there was fill of 380 mm. The 2004 bed level was 10 mm higher than the 2003 bed level.

4.5.3.3 Chain 3 (SM08-3)

This chain was located on 26 October 2004 and was orientated upstream and curling towards the left bank and downstream.

- Depth to first link……..306 mm
- Depth to first vertical link…….315 mm
- Depth to straightened chain……35 mm (2003 bed level)

These measurements show that during the 2003/2004 wet season the bed was scoured to a maximum depth of 280 mm and then there was subsequent fill of 315 mm. The 2004 bed level was 35 mm higher than the 2003 bed level.

For the 2003/2004 wet season there was 287 mm of scour and 364 mm of fill.

5 Particle size results

The locations of the channel cross sections on each of the six reaches at which the bed material was bulk sampled are shown in the relevant figures in section 3. Oven dry sample masses collected for each reach for 2004 are summarised in table 3. From the criteria of de Vries (1970), Church et al (1987) and Gale & Hoare (1992), the sample masses are adequate to obtain reproducible measures of the grain size distribution for these bed material sediments. The cumulative frequency grain size distributions and Folk (1954; 1974) texture group for every sediment sample collected are contained in Appendix B, tables B1 to B6 inclusive.

Table 3 Summary of oven dry, bulk bed material sample masses collected for each reach of Ngarradj creek for 2004

Sample Mass	Tributary North main channel	Tributary North tributary channel	Tributary Central	East Tributary	Upper Swift Creek	Swift Creek
No. of samples	8	5	14	8	8	8
Mean (g)	1257.29	999.56	1337.7	1460.5	1573.9	2160.4
Standard Error of Estimate (g)	96.33	84.01	53.4	107.1	125.3	88.6
Minimum (g)	871.89	820.97	983.1	1082.8	788.6	1911.9
Maximum (g)	1612.22	1305.92	1629.8	2004.2	1944.5	2593.1

The grain size statistics for the bulk bed material samples for each of the reaches collected in 2004 are shown in tables 4 to 9 inclusive. Particle size distributions for the period 1998 to 2003 are shown in Saynor et al 2005. The distributions for 2004 are not shown here as only one additional year of data has been collected and it is unlikely that there will be any change in the distribution envelope shown in Saynor et 2005. They can be drawn up in future from the data in Appendix B if and when required.

Table 4 Grain size statistics for the bulk bed material samples at the cross sections on the main gully of Tributary North for 2004. See fig 64 for location of cross sections.

Date	Sample Name	Graphic Mean ϕ	Graphic S.D. ϕ	Skewness	Graphic Kurtosis	Normal Kurtosis
18-Aug-04	TN01	1.72	1.76	0.27	1.71	0.63
16-Aug-04	TN02	0.97	0.75	0.02	1.12	0.53
17-Aug-04	TN03	1.41	1.22	-0.04	1.18	0.54
17-Aug-04	TN04	1.07	1.12	-0.14	1.60	0.62
17-Aug-04	TN06	1.35	0.86	-0.01	1.25	0.55
17-Aug-04	TN07	1.39	0.74	-0.08	0.94	0.49
17-Aug-04	TN08	0.98	1.09	-0.05	1.30	0.57
17-Aug-04	TN09	1.39	1.10	0.10	1.36	0.58
	Average	1.22	0.98	-0.03	1.25	0.55
	SEE	0.09	0.12	0.04	0.09	0.02

Table 5 Grain size statistics for the bulk bed material samples at the cross sections on the tributary gully of Tributary North between for 2004. See fig 64 for location of cross sections.

Date	Sample Name	Graphic Mean ϕ	Graphic S.D. ϕ	Skewness	Graphic Kurtosis	Normal Kurtosis
14-Aug-03	TN04	1.46	1.21	0.34	1.76	0.64
14-Aug-03	TN05	1.58	1.43	0.41	1.88	0.65
14-Aug-03	TN06	1.30	1.28	0.35	2.12	0.68
14-Aug-03	TN07	1.51	0.96	0.10	1.61	0.62
14-Aug-03	TN08	1.17	1.39	-0.30	1.48	0.60
	Average	1.39	1.26	0.14	1.77	0.64
	SEE	0.08	0.09	0.14	0.13	0.02

Table 6 Grain size statistics for the bulk bed material samples at the cross sections on Tributary Central for 2004. See fig 21 for location of cross sections.

Date	Sample Name	Graphic Mean ϕ	Graphic S.D. ϕ	Skewness	Graphic Kurtosis	Normal Kurtosis
8-Sep-04	TC06A	1.21	0.72	-0.02	1.16	0.54
8-Sep-04	TC06B	0.98	0.97	-0.20	1.41	0.58
8-Sep-04	TC06C	1.13	0.97	-0.21	1.25	0.56
8-Sep-04	TC07A	-0.61	2.55	-0.42	0.60	0.37
8-Sep-04	TC07B	-0.46	2.47	-0.34	0.67	0.40
8-Sep-04	TC07C	1.09	2.29	-0.31	2.59	0.72
8-Sep-04	TC08	-0.28	2.74	-0.56	0.83	0.45
8-Sep-04	TC09	-0.39	2.67	-0.35	0.66	0.40
8-Sep-04	TC10	-2.36	2.78	0.27	0.67	0.40
8-Sep-04	TC05	-1.07	1.87	0.59	0.36	0.26
8-Sep-04	TC11	1.47	1.43	-0.39	2.26	0.69
8-Sep-04	TC04	1.37	1.43	-0.05	1.66	0.62
8-Sep-04	TC03	0.99	0.96	-0.10	1.13	0.53
8-Sep-04	TC01	-0.14	1.82	0.00	0.35	0.26
	Average	0.21	1.83	-0.15	1.11	0.49
	SEE	0.30	0.20	0.08	0.18	0.04

Table 7 Grain size statistics for the bulk bed material samples at the cross sections on East Tributary for 2004. See fig 5 for location of cross sections.

Date	Sample Name	Graphic Mean ϕ	Graphic S.D. ϕ	Skewness	Graphic Kurtosis	Normal Kurtosis
9-Sep-04	ET01	1.15	0.63	-0.02	1.02	0.50
9-Sep-04	ET02	1.12	0.93	-0.22	1.26	0.56
9-Sep-04	ET03	0.71	1.27	-0.35	1.35	0.57
9-Sep-04	ET04	0.32	1.45	-0.22	0.82	0.45
9-Sep-04	ET05	0.70	0.91	-0.25	1.18	0.54
9-Sep-04	ET06	0.78	1.01	-0.29	1.23	0.55
9-Sep-04	ET07	1.07	1.01	-0.16	1.21	0.55
9-Sep-04	ET08	0.50	1.29	-0.26	1.03	0.51
	Average	0.79	1.06	-0.22	1.14	0.53
	SEE	0.11	0.09	0.04	0.06	0.01

Table 8 Grain size statistics for the bulk bed material samples at the cross sections on Upper Swift Creek for 2004. See fig 46 for location of cross sections.

Date	Sample Name	Graphic Mean ϕ	Graphic S.D. ϕ	Skewness	Graphic Kurtosis	Normal Kurtosis
18-Aug-04	UM01	1.57	0.64	-0.01	1.01	0.50
18-Aug-04	UM02	0.75	0.90	-0.22	1.34	0.57
18-Aug-04	UM03	0.87	0.85	-0.09	1.04	0.51
18-Aug-04	UMGW	1.03	0.74	-0.01	1.09	0.52
18-Aug-04	UM04	0.88	0.94	-0.18	1.32	0.57
9-Sep-04	UM05	0.93	0.83	-0.21	1.39	0.58
9-Sep-04	UM06	0.97	0.74	-0.08	1.16	0.54
9-Sep-04	UM07	0.81	0.70	-0.08	1.30	0.57
	Average	0.98	0.79	-0.11	1.21	0.55
	SEE	0.24	0.10	0.08	0.14	0.03

Table 9 Grain size statistics for the bulk bed material samples at the cross sections on Swift Creek for 2004. See fig 55 for location of cross sections.

Date	Sample Name	Graphic Mean ϕ	Graphic S.D. ϕ	Skewness	Graphic Kurtosis	Normal Kurtosis
9-Sep-04	SM05	1.02	0.85	-0.10	1.13	0.53
9-Sep-04	SM03	0.91	0.77	-0.10	1.07	0.52
9-Sep-04	SM02	1.30	0.77	-0.16	1.26	0.56
9-Sep-04	SM01	0.87	0.91	-0.20	1.12	0.53
9-Sep-04	SM06	0.77	0.87	-0.20	1.12	0.53
8-Sep-04	SM04	0.92	0.87	-0.04	1.08	0.52
8-Sep-04	SM07	1.01	0.85	-0.16	1.22	0.55
8-Sep-04	SM08	0.76	1.07	-0.32	1.18	0.54
	Average	0.95	0.87	-0.16	1.15	0.53
	SEE	0.06	0.03	0.03	0.02	0.01

6 Conclusions and recommendations

The channel cross sectional data, scour chain and particle size data collected in the Ngarradj catchment for 2004 are presented in this report. There are 56 permanently monumented cross sections installed in the Ngarradj catchment that have had various samples and parameters collected for the period 1998 through to 2004.

There is now an excellent baseline data set against which impacts can be evaluated should the Jabiluka project proceed in the future. It is therefore recommended that data acquisition for the determination of channel stability in the Ngarradj catchment be suspended until there is an indication that any further development will occur.

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Appendix A

This appendix contains the survey data for each cross section for the 2004 dry season. The sections are listed in increasing numerical order which does not always correspond to their location in downstream sequence. Refer to the relevant diagrams in Section 3 to determine where they are located.

The datum used for each section is an assumed datum with a horizontal angle of either 0°, 90°, 180°, 270° so that there is a distance (chainage) and a height for each survey point. All measurements are in metres and each cross section is independent of each other cross section. The assumed datum is often different between cross sections.

The location of the data files on the ***eriss*** network is in the following directories:

\\Landscape Characterisation and Monitoring\Jabiluka\(Dry) Channel stability in the Ngarradj catchment\Data\Survey xsections*location*

where *location* refers to one of the five sites at which the cross sections are located, namely Tributary North, Tributary Central, East Tributary, Upper Swift Creek and Swift Creek.

Tributary North Cross sections 1 to 4 2004							
TN01 Distance (m)	**18-Aug-04 Assumed Height (m)**	**TN02 Distance (m)**	**16-Aug-04 Assumed Height (m)**	**TN03 Distance (m)**	**17-Aug-04 Assumed Height (m)**	**TN04 Distance (m)**	**17-Aug-04 Assumed Height (m)**
4968.945	10.993	3974.714	9.862	2977.916	9.981	1973.517	10.259
4969.098	10.784	3974.713	9.864	2977.919	9.981	1973.657	10.056
4972.031	10.746	3974.844	9.674	2978.07	9.797	1976.625	10.016
4974.341	10.698	3977.177	9.638	2980.403	9.729	1979.35	10.002
4976.49	10.627	3979.276	9.602	2982.545	9.682	1981.945	9.968
4979.151	10.568	3980.541	9.569	2984.095	9.642	1984.242	9.891
4980.513	10.522	3981.245	9.462	2984.462	9.608	1984.766	9.811
4981.137	10.457	3981.85	9.285	2984.724	9.559	1985.375	9.629
4981.523	10.38	3982.293	9.085	2985.338	9.291	1985.818	9.475
4982.143	10.002	3982.745	8.933	2985.761	9.105	1986.057	9.284
4982.586	9.779	3983.268	8.858	2985.996	9.049	1986.535	9.121
4982.949	9.721	3983.428	8.684	2986.09	8.958	1986.618	8.994
4983.095	9.47	3983.561	8.596	2986.557	8.815	1986.699	8.871
4983.276	9.442	3983.703	8.43	2986.811	8.619	1986.999	8.754
4983.508	9.514	3984.208	8.494	2986.986	8.5	1987.194	8.518
4983.683	9.683	3984.733	8.577	2987.572	8.448	1987.402	8.552
4984.086	9.685	3984.863	8.743	2987.919	8.445	1987.748	8.662
4984.795	9.789	3985.121	8.927	2988.143	8.549	1988.129	8.808
4984.873	9.89	3985.713	9.07	2988.272	8.737	1988.279	8.913
4985.162	10.048	3986.18	9.188	2988.592	8.909	1988.422	9.09
4985.336	10.119	3987.082	9.292	2988.932	9.144	1988.591	9.168
4985.454	10.196	3987.943	9.459	2989.82	9.505	1989.19	9.27
4985.738	10.23	3989.626	9.566	2990.228	9.641	1989.688	9.356
4985.835	10.41	3992.038	9.652	2990.489	9.674	1990.812	9.38
4986.675	10.493	3994.483	9.726	2992.931	9.673	1992.028	9.467
4989.426	10.584	3998.209	9.833	2995.714	9.721	1992.639	9.497
4992.116	10.665			2998.132	9.785	1993.147	9.452
4994.762	10.739					1994.726	9.462
4998.468	10.784					1996.146	9.463
5001.994	10.802					1996.883	9.516
5005.824	10.778					1997.541	9.576
5008.613	10.737					1998.854	9.729
5011.84	10.677					2001.505	9.812
5012.564	10.656					2004.006	9.823
5013.331	10.677					2005.599	9.828
5013.802	10.632					2006.578	9.813
5014.124	10.651					2007.452	9.698
5016.99	10.637					2007.773	9.603
5020.637	10.652					2008.009	9.503

Tributary North Cross sections 1 to 4 2004							
TN01 Distance (m)	**18-Aug-04 Assumed Height (m)**	**TN02 Distance (m)**	**16-Aug-04 Assumed Height (m)**	**TN03 Distance (m)**	**17-Aug-04 Assumed Height (m)**	**TN04 Distance (m)**	**17-Aug-04 Assumed Height (m)**
5024.678	10.69					2008.25	9.429
5027.304	10.756					2008.675	9.33
5030.89	10.869					2009.262	9.323
5034.248	10.956					2009.814	9.358
5037.131	10.874					2010.609	9.456
5040.163	10.804					2011.537	9.645
5044.694	10.75					2012.486	9.818
5049.372	10.736					2013.318	9.894
5054.324	10.727					2014.248	9.937
5060.264	10.733					2014.728	9.907
5064.876	10.757					2014.943	9.832
5068.442	10.745					2015.184	9.774
						2015.29	9.688
						2015.528	9.631
						2015.824	9.572
						2016.24	9.456
						2016.339	9.384
						2016.596	9.264
						2016.695	9.191
						2017.062	9.033
						2017.732	8.915
						2018.183	8.857
						2018.521	8.873
						2019.076	8.93
						2019.692	9.057
						2019.832	9.244
						2020.243	9.478
						2020.447	9.774
						2021.197	9.919
						2022.369	9.966
						2023.83	9.972
						2026.107	9.974

Tributary North Cross sections 5 to 8 2004							
TN05 Distance (m)	**17-Aug-04 Assumed Height (m)**	**TN06 Distance (m)**	**17-Aug-04 Assumed Height (m)**	**TN07 Distance (m)**	**17-Aug-04 Assumed Height (m)**	**TN08 Distance (m)**	**17-Aug-04 Assumed Height (m)**
3523.967	9.879	1972.292	8.625	1976.311	8.726	4964	7.782
3523.958	9.879	1974.633	8.597	1978.753	8.655	4964	7.782
3523.83	9.701	1976.667	8.57	1980.981	8.623	4964.139	7.58
3521.863	9.713	1978.621	8.53	1982.058	8.609	4966.238	7.528
3519.494	9.721	1979.176	8.463	1982.467	8.549	4968.715	7.472
3517.158	9.723	1979.83	8.251	1983.66	8.117	4969.51	7.458
3515.54	9.715	1980.691	7.973	1984.566	7.898	4970.071	7.416
3514.771	9.711	1980.969	7.826	1985.222	7.773	4970.813	7.298
3514.11	9.559	1981.471	7.718	1985.636	7.646	4971.368	7.163
3513.045	9.185	1982.112	7.633	1986.242	7.533	4971.781	7.06
3512.567	9.02	1982.302	7.59	1986.407	7.576	4972.735	6.948
3512.41	8.943	1982.372	7.49	1986.78	7.761	4973.779	6.868
3511.822	8.826	1982.461	7.482	1986.932	7.953	4974.648	6.84
3511.421	8.755	1982.527	7.372	1987.194	8.062	4975.061	6.874
3511.076	8.722	1982.679	7.365	1987.593	8.224	4975.57	6.858
3510.288	8.795	1983.083	7.522	1988.546	8.407	4976.057	6.754
3510.013	8.839	1983.537	7.557	1990.024	8.556	4976.274	6.7
3509.785	8.906	1983.765	7.703	1991.358	8.672	4976.766	6.664
3509.539	9.032	1984.079	7.779	1993.74	8.717	4977.167	6.582
3509.208	9.235	1984.495	8.019	1996.296	8.729	4977.507	6.514
3508.83	9.384	1985.503	8.217	1998.708	8.792	4977.706	6.433
3508.574	9.464	1986.376	8.234	2001.895	8.837	4978.066	6.374
3508.134	9.678	1988.017	8.227	2005.321	8.913	4978.399	6.36
3507.318	9.734	1988.536	8.342	2008.207	8.964	4978.816	6.41
3505.119	9.742	1988.696	8.442	2010.78	9.004	4979.11	6.513
3501.616	9.799	1989.411	8.508	2013.42	9.015	4979.607	6.886
		1991.384	8.561	2015.59	9.025	4979.873	7.034
		1994.075	8.626	2017.717	9.045	4980.295	7.205
		1996.504	8.711	2018.314	9.002	4981.115	7.492
		1998.664	8.766	2018.555	8.883	4981.321	7.622
		2001.435	8.816	2018.906	8.749	4982.01	7.699
		2002.904	8.847	2019.537	8.55	4983.538	7.746
		2004.694	8.851	2020.138	8.317	4984.697	7.775
		2005.508	8.822	2020.671	8.055	4985.995	7.805
		2005.762	8.75	2020.996	8.011	4986.543	7.777
		2006.087	8.659	2021.21	7.961	4986.793	7.707
		2006.134	8.421	2021.636	7.841	4987.249	7.468
		2006.258	8.228	2021.954	7.866	4987.805	7.244
		2006.696	8.007	2022.399	7.997	4987.961	7.141

Tributary North Cross sections 5 to 8 2004							
TN05 Distance (m)	**17-Aug-04 Assumed Height (m)**	**TN06 Distance (m)**	**17-Aug-04 Assumed Height (m)**	**TN07 Distance (m)**	**17-Aug-04 Assumed Height (m)**	**TN08 Distance (m)**	**17-Aug-04 Assumed Height (m)**
		2007.431	7.75	2023.009	8.049	4988.472	6.944
		2007.688	7.702	2023.794	8.176	4989.172	6.747
		2008.052	7.667	2024.45	8.333	4989.598	6.65
		2008.538	7.733	2024.744	8.464	4989.689	6.528
		2008.761	7.83	2024.978	8.505	4989.897	6.526
		2009.176	7.846	2025.649	8.693	4990.181	6.541
		2009.838	7.924	2026.077	8.859	4990.361	6.623
		2010.007	7.999	2026.606	9	4990.4	6.802
		2010.408	8.165	2027.753	9.011	4990.67	6.952
		2010.763	8.39	2029.948	9.008	4991.141	7.165
		2010.99	8.627	2031.689	8.976	4991.877	7.316
		2011.069	8.81			4992.795	7.507
		2011.412	8.827			4993.184	7.597
		2012.317	8.909			4993.35	7.641
		2013.18	8.887			4993.449	7.73
		2015.159	8.881			4993.969	7.816
		2017.873	8.876			4995.971	7.837
		2020.876	8.873			4998.212	7.813
		2021.028	9.066				
		2021.038	9.066				

Tributary North Cross sections 9 to 12 2004							
TN09 Distance (m)	**17-Aug-04 Assumed Height (m)**	**TN10 Distance (m)**	**17-Aug-04 Assumed Height (m)**	**TN11 Distance (m)**	**17-Aug-04 Assumed Height (m)**	**TN12 Distance (m)**	**17-Aug-04 Assumed Height (m)**
3969.691	8.157	5090.487	12.273	7077.01	13.174	7927.311	13.16
3969.691	8.157	5090.487	12.273	7077.007	13.174	7927.309	13.162
3969.824	7.961	5090.345	12.064	7076.872	12.986	7927.449	12.959
3973.008	7.956	5087.478	12.04	7073.15	12.806	7930.267	12.962
3976.024	7.912	5085.362	11.977	7070.14	12.58	7933.024	12.963
3977.995	7.88	5082.832	11.845	7068.739	12.421	7935.152	12.944
3978.664	7.808	5080.883	11.773	7068.137	12.323	7936.074	12.997
3979.044	7.685	5080.244	11.689	7067.681	12.258	7937.417	13.082
3979.496	7.528	5080.05	11.446	7067.201	12.225	7938.839	13.007
3980.275	7.171	5079.646	11.347	7066.489	12.177	7940.363	12.905
3980.741	6.897	5079.083	11.323	7065.834	12.245	7941.899	12.858
3980.982	6.832	5078.432	11.4	7065.153	12.382	7942.588	12.78
3981.917	6.757	5078.116	11.505	7064.443	12.483	7942.874	12.697
3982.775	6.712	5077.991	11.567	7062.958	12.566	7943.558	12.662
3983.318	6.637	5077.885	11.701	7059.578	12.618	7944.066	12.638
3983.663	6.561	5077.188	11.741	7056.317	12.636	7944.225	12.466
3983.974	6.553	5074.165	11.816	7053.451	12.615	7944.845	12.448
3984.172	6.523	5070.701	11.804	7049.549	12.571	7945.093	12.434
3985.073	6.582	5066.935	11.787	7046.346	12.553	7945.406	12.407
3985.338	6.623	5062.515	11.755	7043.5	12.553	7945.772	12.623
3985.631	6.606	5058.947	11.747	7041.153	12.566	7945.956	12.794
3986.237	6.651	5057.489	11.742	7038.479	12.627	7946.141	12.842
3986.522	6.718	5056.123	11.838	7037.624	12.643	7947.03	12.969
3986.674	6.775	5052.791	11.877	7037.253	12.564	7948.939	12.922
3987.314	6.838	5050.882	11.88	7036.643	12.575	7952.087	12.85
3987.783	7.054	5050.267	11.819	7036.152	12.605	7955.263	12.849
3987.949	7.158	5049.576	11.845	7035.897	12.596	7958.485	12.799
3988.742	7.391	5048.58	11.818	7035.515	12.372	7962.024	12.786
3989.065	7.481	5048.087	11.828	7035.179	12.329	7966.089	12.714
3989.463	7.558	5044.991	11.814	7034.607	12.37	7969.583	12.675
3990.018	7.617	5041.527	11.747	7034.283	12.426	7973.53	12.624
3992.199	7.636	5037.64	11.644	7033.886	12.668	7977.411	12.59
3994.913	7.709	5033.891	11.588	7032.179	12.677	7979.862	12.555
3997.701	7.781	5030.85	11.551	7029.505	12.598	7980.958	12.498
		5027.032	11.57	7026.717	12.607	7982.275	12.504
		5023.099	11.563	7023.354	12.618	7983.67	12.489
		5019.441	11.574	7020.418	12.637	7984.059	12.397
		5014.65	11.585	7018.081	12.705	7984.477	12.313
		5010.848	11.643	7013.972	12.677	7984.667	12.27

Tributary North Cross sections 9 to 12 2004							
TN09 Distance (m)	**17-Aug-04 Assumed Height (m)**	**TN10 Distance (m)**	**17-Aug-04 Assumed Height (m)**	**TN11 Distance (m)**	**17-Aug-04 Assumed Height (m)**	**TN12 Distance (m)**	**17-Aug-04 Assumed Height (m)**
		5007.441	11.724	7009.927	12.708	7985.387	12.222
		5002.257	11.793	7005.837	12.758	7986.049	12.27
				7001.823	12.791	7986.337	12.312
						7986.586	12.422
						7987.119	12.503
						7988.42	12.474
						7990.485	12.554
						7993.131	12.666
						7995.798	12.772
						7998.045	12.81

Tributary North Cross section 13 2004			
TN13 Distance (m)	**17-Aug-04 Assumed Height (m)**	**TN13 Cont. Distance (m)**	**17-Aug-04 Assumed Height (m)**
8960.523	14.264	8988.086	13.537
8960.521	14.265	8988.931	13.566
8960.667	14.065	8989.508	13.508
8964.668	14.027	8989.765	13.425
8967.596	13.934	8990.023	13.395
8970.637	13.872	8990.339	13.49
8973.806	13.76	8990.52	13.59
8976.331	13.731	8990.708	13.613
8978.883	13.699	8992.801	13.708
8980.97	13.672	8995.37	13.72
8981.464	13.596	8998.089	13.838
8981.899	13.546		
8982.238	13.542		
8982.444	13.557		
8983.078	13.532		
8983.398	13.474		
8983.822	13.505		
8986.508	13.445		
8960.523	14.264		

Tributary Central Cross sections 1-4 2004							
TC01 Distance (m)	**8-Sep-04 Assumed Height (m)**	**TC02 Distance (m)**	**8-Sep-04 Assumed Height (m)**	**TC03 Distance (m)**	**8-Sep-04 Assumed Height (m)**	**TC04 Distance (m)**	**8-Sep-04 Assumed Height (m)**
4962.511	11.246	1981.392	11.087	5962.265	12.297	6956.917	12.219
4962.497	11.246	1981.531	10.941	5962.257	12.296	6956.918	12.219
4962.664	11.074	1982.181	10.973	5962.391	12.127	6957.041	12.069
4964.596	11.167	1982.927	10.967	5965.158	12.125	6960.011	11.992
4967.513	10.976	1983.655	10.977	5968.136	12.002	6964.069	11.958
4971.439	10.831	1984.636	10.937	5972.649	11.92	6968.08	11.891
4974.705	10.806	1985.502	10.969	5976.47	12.003	6972.024	11.844
4977.421	10.795	1986.376	10.963	5979.691	12.071	6975.244	11.824
4979.267	11.011	1987.194	11.013	5981.831	12.154	6978.309	11.816
4981.48	11.05	1988.077	11.031	5982.302	12.144	6981.046	11.971
4984.299	11.052	1989.042	11.062	5982.462	11.989	6983.407	12.092
4986.094	11.037	1990.112	11.092	5982.638	11.873	6983.93	12.025
4986.686	10.873	1990.905	11.075	5983.067	11.72	6984.196	11.873
4987.128	10.905	1991.776	11.017	5983.479	11.591	6984.339	11.833
4987.38	11.046	1992.636	11.043	5983.671	11.504	6984.535	11.504
4988.375	11.1	1993.431	11.006	5983.982	11.391	6984.719	11.35
4988.886	11.093	1994.31	10.966	5984.743	11.432	6984.894	11.171
4989.45	11.133	1995.175	10.954	5985.414	11.444	6985.188	11.005
4990.177	11.143	1995.814	10.965	5985.767	11.505	6985.408	10.917
4990.746	11.154	1996.515	10.931	5986.171	11.77	6985.729	10.878
4991.007	11.251	1997.053	11.01	5986.657	11.985	6986.21	10.867
4991.281	11.092	1997.776	10.926	5986.798	12.131	6986.7	10.865
4991.344	10.699	1998.443	10.905	5987.531	12.178	6987.029	10.907
4991.584	10.61			5988.082	12.064	6987.442	11.027
4991.993	10.488			5989.114	12.104	6987.661	11.166
4992.697	10.49			5990.743	12.029	6987.962	11.322
4993.315	10.484			5992.544	11.973	6988.052	11.5
4994.042	10.488			5994.445	11.931	6988.501	12.01
4994.248	10.577			5997.164	11.892	6988.82	12.108
4994.491	10.767					6989.545	12.061
4994.839	10.926					6991.617	11.952
4995.062	10.969					6993.347	11.95
4995.26	11.094					6994.703	11.922
4995.738	11.019					6997.212	11.863
4996.693	11.042						
4998.353	10.943						
5003.426	10.879						

Tributary Central Cross sections 5-6C 2004							
TC05 Distance (m)	**8-Sep-04 Assumed Height (m)**	**TC06A Distance (m)**	**8-Sep-04 Assumed Height (m)**	**TC06B Distance (m)**	**8-Sep-04 Assumed Height (m)**	**TC06C Distance (m)**	**8-Sep-04 Assumed Height (m)**
7942.501	12.573	9031.356	14.451	0.000	14.18	0.000	13.642
7942.502	12.573	9031.345	14.45	0.138	14.001	0.136	13.444
7942.63	12.387	9031.211	14.268	1.549	13.977	1.372	13.472
7945.454	12.333	9028.521	14.262	3.641	14.001	3.042	13.51
7949.006	12.274	9024.944	14.278	5.975	14.028	5.287	13.621
7952.557	12.215	9022.042	14.259	7.662	14.058	7.338	13.726
7954.93	12.197	9019.673	14.236	9.146	14.064	9.215	13.808
7958.354	12.108	9018.42	14.227	9.997	14.045	10.335	13.815
7961.117	12.035	9017.533	14.169	10.287	14.012	11.272	13.897
7963.579	11.924	9017.217	14.142	10.426	13.917	11.786	13.866
7965.179	11.934	9017.034	13.555	10.550	13.89	11.995	13.809
7966.291	11.98	9016.872	13.413	10.627	13.057	12.199	13.548
7967.375	12.06	9016.548	13.245	10.828	12.795	12.413	13.396
7968.315	11.998	9016.364	12.768	11.062	12.651	12.604	13.277
7968.414	11.595	9016.142	12.639	11.299	12.615	12.873	13.187
7968.838	11.479	9015.976	12.653	11.701	12.785	13.184	12.992
7969.145	11.346	9015.777	12.72	12.177	12.897	13.490	12.611
7969.208	11.116	9015.56	12.683	13.291	12.913	13.800	12.472
7969.539	10.93	9015.141	12.673	13.844	12.956	13.992	12.468
7970.044	10.845	9014.724	12.668	14.507	13.058	14.727	12.733
7970.399	10.839	9014.127	12.774	15.107	13.213	14.990	12.735
7971.105	10.874	9013.383	12.857	15.356	13.196	15.657	12.928
7971.783	10.867	9012.999	12.891	15.569	13.215	16.477	13.105
7972.344	10.959	9012.616	12.965	15.842	13.189	16.994	13.135
7972.498	11.185	9012.314	13.056	16.155	13.253	17.393	13.166
7972.832	11.231	9011.561	13.204	16.998	13.389	17.727	13.118
7973.13	11.489	9010.614	13.283	18.005	13.547	17.981	13.172
7973.405	11.589	9009.913	13.304	18.759	13.584	18.693	13.174
7973.804	11.805	9009.499	13.421	19.270	13.562	19.350	13.216
7974.119	12.036	9008.668	13.508	19.981	13.458	19.844	13.314
7975.013	12.136	9007.819	13.522	20.462	13.459	20.321	13.372
7976.273	12.107	9007.046	13.592	21.198	13.524	20.815	13.317
7978.011	12.03	9006.533	13.612	21.941	13.588	21.162	13.34
7979.514	11.997	9005.911	13.611	22.729	13.585	22.041	13.376
7980.733	11.987	9005.522	13.543	23.535	13.557	22.916	13.301
7981.956	11.902	9005.109	13.547	24.693	13.56	23.494	13.27
7982.702	11.837	9004.363	13.61	25.913	13.619	24.075	13.411
7983.365	11.773	9003.621	13.669	26.653	13.687	25.238	13.47
7984.076	11.764	9002.963	13.725	27.348	13.72	26.240	13.46

Tributary Central Cross sections 5-6C 2004							
TC05 Distance (m)	**8-Sep-04 Assumed Height (m)**	**TC06A Distance (m)**	**8-Sep-04 Assumed Height (m)**	**TC06B Distance (m)**	**8-Sep-04 Assumed Height (m)**	**TC06C Distance (m)**	**8-Sep-04 Assumed Height (m)**
7984.776	11.779	9002.119	13.736	28.259	13.733	27.662	13.502
7985.426	11.873	9000.979	13.776	29.185	13.762	28.586	13.571
7986.259	11.979					30.124	13.679
7987.175	12.018					31.395	13.737
7988.794	11.99					32.576	13.753
7990.681	11.95						
7993.303	11.91						
7995.181	11.877						
7997.092	11.847						

Tributary Central Cross sections 7A-8 2004							
TC07A Distance (m)	**8-Sep-04 Assumed Height (m)**	**TC07B Distance (m)**	**8-Sep-04 Assumed Height (m)**	**TC07C Distance (m)**	**8-Sep-04 Assumed Height (m)**	**TC08 Distance (m)**	**8-Sep-04 Assumed Height (m)**
1032.892	13.09	0.150	12.793	0.000	13.014	5976.1	12.758
1030.739	13.142	2.049	12.899	0.116	12.824	5976.105	12.758
1028.948	13.201	4.184	12.96	1.946	12.804	5976.231	12.558
1026.791	13.25	6.020	12.99	4.326	12.811	5977.971	12.564
1025.14	13.27	7.014	13.024	7.127	12.842	5979.053	12.593
1023.836	13.254	8.143	13	9.334	12.858	5980.351	12.505
1023.656	12.385	8.198	12.262	11.786	12.883	5981.266	12.408
1023.22	11.975	8.464	12.084	13.996	12.925	5981.803	12.294
1022.731	11.676	8.680	11.828	15.258	12.927	5982.136	12.171
1022.473	11.496	8.899	11.583	16.030	12.909	5982.558	12.003
1021.488	11.442	9.184	11.483	16.445	12.843	5982.976	11.859
1020.865	11.503	9.334	11.172	16.544	12.051	5983.377	11.731
1020.209	11.418	9.828	11.035	16.806	11.948	5983.934	11.503
1019.507	11.374	10.043	11.312	17.019	11.728	5984.162	11.331
1018.634	11.347	10.191	11.275	17.511	11.438	5984.365	11.198
1018.04	11.408	10.277	11.093	17.854	11.192	5984.563	11.068
1017.375	11.49	10.497	11.12	18.299	10.952	5984.687	10.927
1016.697	11.686	10.809	11.261	18.783	10.934	5985.047	10.838
1016.054	11.849	11.132	11.29	19.500	11.049	5985.515	10.815
1015.74	11.848	11.510	11.414	19.905	11.161	5985.772	10.865
1015.463	11.803	12.076	11.415	20.091	11.366	5985.974	10.852
1014.998	11.749	12.745	11.51	20.694	11.782	5986.166	10.809
1014.355	11.839	13.276	11.661	21.105	11.834	5986.38	10.848
1013.749	11.948	14.226	11.805	21.708	11.928	5986.729	11.07
1013.093	12.118	15.428	11.878	22.118	12.017	5987.288	11.332
1012.462	12.156	15.965	11.978	22.613	12.143	5987.985	11.674
1011.651	12.201	16.564	12.077	23.051	12.113	5988.758	12.042
1010.641	12.166	17.850	12.213	23.274	12.365	5989.257	12.255
1009.649	12.187	18.982	12.24	24.269	12.405	5989.72	12.438
1008.568	12.249	20.102	12.333	25.620	12.508	5990.021	12.534
1008.047	12.286	21.387	12.407	26.716	12.518	5991.152	12.69
1007.441	12.48	21.765	12.537	27.659	12.594	5992.61	12.757
1006.285	12.436	22.938	12.514	28.704	12.636	5993.77	12.761
1005.857	12.476	23.853	12.496	30.280	12.669	5995.113	12.805
1005.463	12.548	25.198	12.516			5996.564	12.828
1004.443	12.482	27.661	12.65			5998.286	12.829
1003.635	12.53						
1001.781	12.637						

Tributary Central Cross sections 9-11 2004					
TC09 Distance (m)	8-Sep-04 Assumed Height (m)	TC10 Distance (m)	8-Sep-04 Assumed Height (m)	TC11 Distance (m)	8-Sep-04 Assumed Height (m)
8962.469	13.122	7965.299	12.867	6969.907	13.067
8962.467	13.121	7965.438	12.687	6969.913	13.067
8962.598	12.929	7967.499	12.676	6970.037	12.879
8964.376	12.883	7970.131	12.688	6972.032	12.844
8966.961	12.854	7972.251	12.714	6974.876	12.798
8969.071	12.873	7973.883	12.756	6976.999	12.784
8971.002	12.908	7975.352	12.801	6978.663	12.79
8972.539	12.886	7976.441	12.793	6979.483	12.763
8973.147	12.858	7976.963	12.69	6979.691	12.668
8973.442	12.78	7977.024	12.379	6979.973	12.098
8973.631	12.751	7977.27	12.303	6980.064	12.014
8973.696	12.479	7977.389	12.17	6980.109	11.894
8973.915	12.359	7977.704	11.977	6980.323	11.79
8974.104	12.232	7978.004	11.892	6980.428	11.439
8974.301	11.939	7978.387	11.78	6980.599	11.267
8974.633	11.751	7978.703	11.703	6980.941	11.274
8974.793	11.687	7978.94	11.536	6981.373	11.456
8974.935	11.584	7979.308	11.495	6981.796	11.517
8975.302	11.541	7979.591	11.565	6982.295	11.628
8975.634	11.429	7980.467	11.554	6982.634	11.688
8976.578	11.405	7980.94	11.592	6982.871	11.683
8976.998	11.429	7981.543	11.665	6983.406	11.801
8977.552	11.531	7981.799	11.765	6984.128	12.018
8978.038	11.559	7982.32	11.864	6985.016	12.074
8978.549	11.647	7982.668	12.05	6985.647	11.971
8978.888	11.766	7983.08	12.103	6986.28	12.024
8979.362	12.009	7983.735	12.087	6986.731	12.1
8979.779	12.217	7984.505	12.134	6987.039	12.336
8980.237	12.305	7985.073	12.23	6987.413	12.396
8980.714	12.459	7985.576	12.362	6988.428	12.424
8981.059	12.624	7986.581	12.399	6989.834	12.4
8981.624	12.795	7987.5	12.462	6991.011	12.39
8982.261	12.926	7988.399	12.472	6992.232	12.573
8983.319	13.006	7989.694	12.606	6994.075	12.745
8985.06	12.987	7991.329	12.76	6996.857	12.772
8986.958	12.976	7993.644	12.822		
8988.581	12.952	7995.452	12.763		
8990.392	12.9	7997.463	12.748		
8992.258	12.846				

Tributary Central Cross sections 9-11 2004					
TC09 Distance (m)	**8-Sep-04 Assumed Height (m)**	**TC10 Distance (m)**	**8-Sep-04 Assumed Height (m)**	**TC11 Distance (m)**	**8-Sep-04 Assumed Height (m)**
8994.047	12.822				
8995.758	12.833				
8997.619	12.816				

East Tributary Cross sections 1 to 4- 2004							
ET01 Distance (m)	**9-Sep-04 Assumed Height (m)**	**ET02 Distance (m)**	**9-Sep-04 Assumed Height (m)**	**ET03 Distance (m)**	**9-Sep-04 Assumed Height (m)**	**ET04 Distance (m)**	**9-Sep-04 Assumed Height (m)**
975.7	14.897	1971.699	14.897	2976.631	14.954	3974.111	14.911
975.699	14.897	1971.692	14.897	2976.632	14.954	3974.117	14.911
975.827	14.692	1971.851	14.696	2976.768	14.772	3974.283	14.691
977.296	14.699	1972.931	14.709	2978.504	14.775	3975.681	14.713
978.536	14.691	1974.068	14.731	2980.049	14.785	3977.304	14.737
979.492	14.714	1975.357	14.733	2981.149	14.823	3978.494	14.776
980.409	14.818	1976.136	14.738	2982.275	14.849	3980.317	14.822
981.465	14.848	1976.871	14.725	2983.746	14.874	3981.361	14.852
982.099	14.801	1977.039	14.67	2984.538	14.878	3982.403	14.901
982.393	14.691	1977.188	14.61	2985.129	14.751	3983.042	14.912
982.66	14.594	1977.439	14.319	2985.635	14.692	3983.466	14.843
982.984	14.53	1977.713	14.172	2986.022	14.422	3983.748	14.613
983.142	14.3	1978.012	14.103	2986.125	14.265	3984.044	14.423
983.281	14.169	1978.187	14.061	2986.288	14.24	3984.279	14.342
983.385	14.054	1978.324	13.795	2986.415	14.38	3984.515	14.332
983.552	13.78	1978.842	13.701	2986.744	14.323	3984.738	14.262
983.638	13.626	1979.761	13.594	2986.869	14.078	3984.759	13.652
984.097	13.436	1980.445	13.372	2987.021	13.978	3985.055	13.524
984.191	13.322	1980.976	13.242	2987.218	13.741	3985.359	13.436
984.48	13.252	1981.509	13.073	2987.437	13.576	3985.943	13.357
984.969	13.239	1982.073	12.899	2987.577	13.415	3986.582	13.312
985.793	13.196	1982.368	12.872	2987.808	13.278	3987.094	13.293
986.147	13.091	1982.583	12.94	2988.121	13.193	3987.768	13.386
986.626	13.07	1982.93	12.913	2988.686	13.206	3988.199	13.386
987.324	13.115	1983.392	12.93	2989.187	13.232	3988.648	13.312
987.924	13.085	1983.641	12.95	2989.715	13.284	3988.908	13.319
988.288	13.176	1983.968	12.835	2990.305	13.361	3989.212	13.477
988.424	13.22	1984.471	12.865	2990.788	13.386	3989.623	13.704
988.579	13.503	1984.758	12.931	2991.089	13.323	3989.749	13.884
988.823	13.565	1985.301	13.124	2991.308	13.321	3989.916	13.985
988.99	13.891	1985.55	13.108	2991.594	13.531	3990.207	14.247
989.431	14.043	1985.956	13.088	2992.085	13.66	3990.547	14.502
989.799	14.243	1986.104	13.452	2992.266	13.909	3990.941	14.662
990.271	14.508	1986.528	13.617	2992.38	14.116	3991.374	14.739
990.705	14.677	1986.828	14.074	2992.504	14.164	3991.818	14.736
991.33	14.734	1986.912	14.542	2992.592	14.267	3992.208	14.792
992.445	14.74	1987.019	14.675	2992.768	14.348	3992.503	14.874
993.692	14.734	1987.368	14.789	2992.878	14.56	3993.086	14.895
995.027	14.769	1987.905	14.857	2993.014	14.532	3994.046	14.89

East Tributary Cross sections 1 to 4- 2004							
ET01 Distance (m)	**9-Sep-04 Assumed Height (m)**	**ET02 Distance (m)**	**9-Sep-04 Assumed Height (m)**	**ET03 Distance (m)**	**9-Sep-04 Assumed Height (m)**	**ET04 Distance (m)**	**9-Sep-04 Assumed Height (m)**
996.522	14.81	1988.749	14.861	2993.244	14.678	3995.114	14.886
998.313	14.817	1989.868	14.817	2993.558	14.825	3996.131	14.836
		1990.972	14.82	2994.009	14.907	3997.672	14.819
		1992.211	14.83	2994.667	14.905		
		1993.596	14.809	2995.67	14.878		
		1994.342	14.814	2997.103	14.861		
		1995.39	14.821	2998.312	14.84		
		1997.323	14.825				

East Tributary Cross sections 5 to 8 2004							
ET05 Distance (m)	**9-Sep-04 Assumed Height (m)**	**ET06 Distance (m)**	**9-Sep-04 Assumed Height (m)**	**ET07 Distance (m)**	**9-Sep-04 Assumed Height (m)**	**ET08 Distance (m)**	**9-Sep-04 Assumed Height (m)**
1985.004	9.942	5968.551	14.872	7470.715	14.886	0.140901	14.344
1985.017	9.941	5968.549	14.872	7470.707	14.885	2.432246	14.44
1985.156	9.702	5968.742	14.704	7470.914	14.719	4.401013	14.559
1986.063	9.726	5970.618	14.762	7473.248	14.742	6.54731	14.654
1986.861	9.752	5972.686	14.779	7474.688	14.749	8.822013	14.721
1987.587	9.747	5974.725	14.792	7476.182	14.768	11.25315	14.857
1987.992	9.685	5976.878	14.844	7478.25	14.762	14.11265	14.887
1988.267	9.565	5978.715	14.853	7480.223	14.794	15.95975	14.882
1988.423	9.426	5980.212	14.878	7482.301	14.875	16.67537	14.768
1988.729	9.293	5981.392	14.849	7483.696	14.89	16.99105	14.649
1988.85	9.154	5981.784	14.796	7484.237	14.8	17.33453	14.404
1989.135	9.056	5982.026	14.661	7484.5	14.609	17.58556	14.25
1989.327	8.926	5982.369	14.586	7484.642	14.225	17.69601	14.199
1989.597	8.715	5982.717	14.396	7484.783	14.032	17.73853	13.936
1989.782	8.383	5982.89	14.278	7484.963	13.831	18.27526	13.803
1990.013	8.246	5983.372	14.239	7485.141	13.787	18.38928	13.88
1990.291	8.039	5983.463	14.413	7485.62	13.593	18.4509	13.476
1990.835	8.155	5983.637	14.38	7486.031	13.5	18.75992	13.335
1991.158	8.186	5983.696	14.071	7486.954	13.5	19.16586	13.29
1991.699	8.235	5983.843	13.998	7487.821	13.464	19.27922	13.314
1992.53	8.274	5984.014	13.983	7488.571	13.346	19.58625	12.993
1993.223	8.308	5984.212	13.993	7489.083	13.314	20.17534	13.101
1993.747	8.284	5984.261	13.757	7489.587	13.363	20.97789	13.217
1994.038	8.35	5984.428	13.44	7489.882	13.431	21.77112	13.344
1994.519	8.619	5984.693	13.295	7490.242	13.451	22.44462	13.381
1994.711	8.826	5984.971	13.255	7490.384	13.559	22.90635	13.585
1994.793	9.236	5985.233	13.214	7490.577	14.124	23.23276	13.473
1995.335	9.418	5985.878	13.37	7490.81	14.028	24.4647	13.622
1995.71	9.561	5986.623	13.46	7491.127	14.189	24.94398	13.767
1996.464	9.639	5987.427	13.476	7491.308	14.106	25.634	13.809
1997.534	9.725	5987.872	13.456	7491.662	14.201	26.19625	14.047
1998.585	9.71	5988.254	13.558	7492.111	14.267	26.79518	14.212
		5988.792	13.772	7492.531	14.372	27.23633	14.345
		5988.921	13.829	7493.213	14.537	28.0354	14.371
		5989.225	14.079	7493.736	14.741	28.75359	14.437
		5989.677	14.453	7493.876	14.839	29.56208	14.65
		5990.286	14.684	7494.676	14.905	30.09746	14.812
		5990.838	14.788	7496.05	14.866	31.40236	14.87
		5991.221	14.836	7497.953	14.841	32.83517	14.828

East Tributary Cross sections 5 to 8 2004							
ET05 Distance (m)	**9-Sep-04 Assumed Height (m)**	**ET06 Distance (m)**	**9-Sep-04 Assumed Height (m)**	**ET07 Distance (m)**	**9-Sep-04 Assumed Height (m)**	**ET08 Distance (m)**	**9-Sep-04 Assumed Height (m)**
		5992.19	14.869			34.41233	14.828
		5993.13	14.875				
		5994.539	14.875				
		5995.772	14.875				
		5997.988	14.837				

Upper Swift Creek cross sections 1 to GW 2004							
UM01 Distance (m)	**18-Aug-04 Assumed Height (m)**	**UM02 Distance (m)**	**18-Aug-04 Assumed Height (m)**	**UM03 Distance (m)**	**18-Aug-04 Assumed Height (m)**	**UMGW Distance (m)**	**18-Aug-04 Assumed Height (m)**
2042.907	9.99	2038.579	9.887	2029.57	9.73	2020.155	9.646
2042.908	9.99	2038.577	9.886	2029.565	9.73	2020.157	9.646
2042.832	9.803	2038.447	9.687	2029.41	9.557	2020.047	9.459
2041.596	9.707	2036.484	9.621	2026.871	9.57	2018.763	9.423
2038.937	9.632	2034.959	9.563	2024.848	9.549	2018.033	9.405
2036.601	9.569	2034.558	9.605	2023.576	9.526	2017.582	9.44
2035.618	9.603	2034.108	9.588	2022.859	9.599	2017.266	9.38
2035.193	9.552	2033.664	9.515	2022.515	9.561	2016.906	9.465
2034.687	9.552	2032.359	9.519	2021.634	9.492	2016.487	9.391
2033.03	9.537	2031.807	9.581	2020.961	9.459	2016.107	9.306
2032.258	9.509	2031.547	9.535	2020.446	9.488	2015.936	9.198
2031.914	9.549	2028.982	9.526	2019.858	9.429	2015.612	9.07
2031.458	9.507	2028.389	9.507	2019.381	9.442	2015.265	8.668
2030.933	9.503	2027.793	9.639	2019.155	9.469	2015.195	8.533
2030.607	9.56	2026.34	9.586	2018.884	9.423	2015.055	8.437
2030.187	9.539	2025.231	9.546	2018.235	9.465	2014.932	7.964
2029.722	9.578	2024.829	9.502	2017.858	9.499	2014.629	7.875
2029.422	9.498	2024.227	9.486	2017.292	9.418	2014.018	7.914
2027.805	9.477	2022.715	9.493	2016.731	9.408	2012.821	7.907
2026.678	9.515	2021.569	9.45	2016.268	9.361	2011.535	7.871
2025.456	9.418	2021.223	9.346	2015.393	9.355	2010.919	7.885
2024.37	9.372	2020.872	9.14	2014.992	9.288	2010.601	7.837
2023.612	9.39	2020.394	8.969	2014.791	9.151	2010.334	7.714
2023.026	9.453	2019.737	8.664	2014.18	9.121	2009.98	7.628
2022.77	9.493	2019.648	8.08	2013.926	9.08	2009.745	7.67
2022.209	9.487	2019.144	7.83	2013.622	9.075	2009.158	7.918
2021.928	9.399	2018.462	7.859	2013.443	8.86	2009.037	8.023
2021.474	9.16	2017.205	7.924	2013.302	8.86	2008.818	8.077
2021.378	9.079	2016.081	7.918	2013.11	8.552	2008.634	8.323
2020.425	8.813	2015.423	7.866	2012.871	8.499	2008.459	8.314
2020.274	8.57	2015.129	7.835	2012.827	8.05	2008.349	8.569
2019.597	8.293	2014.869	7.918	2012.622	7.989	2008.061	8.731
2018.926	8.089	2014.753	8.127	2012.306	7.76	2007.583	8.978
2018.164	7.99	2014.405	8.079	2012.011	7.776	2007.496	9.095
2017.848	7.788	2013.889	8.335	2011.687	7.833	2007.005	9.329
2017.569	7.78	2013.395	8.504	2011.237	7.847	2006.704	9.451
2017.238	7.818	2012.864	8.782	2010.741	7.914	2006.221	9.545
2016.927	7.854	2012.058	9.136	2010.334	7.937	2004.603	9.688
2016.206	7.883	2011.606	9.398	2009.208	7.861	2003.321	9.782

Upper Swift Creek cross sections 1 to GW 2004							
UM01 Distance (m)	**18-Aug-04 Assumed Height (m)**	**UM02 Distance (m)**	**18-Aug-04 Assumed Height (m)**	**UM03 Distance (m)**	**18-Aug-04 Assumed Height (m)**	**UMGW Distance (m)**	**18-Aug-04 Assumed Height (m)**
2015.606	7.814	2010.851	9.633	2008.659	7.863	2001.908	9.816
2015.229	7.742	2010.096	9.776	2008.25	7.769		
2014.819	7.747	2009.394	9.811	2007.857	7.982		
2014.658	7.783	2008.45	9.765	2007.475	8.068		
2014.45	7.861	2007.791	9.812	2007.15	8.234		
2014.127	8.047	2005.873	9.812	2006.988	8.377		
2013.459	8.251	2004.067	9.808	2006.803	8.857		
2013.364	8.626	2001.898	9.816	2006.805	8.857		
2013.265	8.65			2006.51	8.958		
2013.141	8.833			2006.345	9.133		
2012.923	9.052			2006.144	9.249		
2012.558	9.22			2005.859	9.319		
2011.97	9.351			2005.358	9.557		
2010.962	9.524			2005.102	9.593		
2010.165	9.586			2004.672	9.553		
2009.62	9.698			2004.054	9.58		
2008.841	9.777			2003.229	9.695		
2008.072	9.757			2002.856	9.764		
2007.464	9.785			2001.553	9.814		
2006.995	9.827						
2005.082	9.771						
2003.626	9.839						
2001.722	9.777						

Upper Swift Creek cross sections 4 to 7 2004							
UM04 Distance (m)	**18-Aug-04 Assumed Height (m)**	**UM05 Distance (m)**	**9-Sep-04 Assumed Height (m)**	**UM06 Distance (m)**	**9-Sep-04 Assumed Height (m)**	**UM07 Distance (m)**	**9-Sep-04 Assumed Height (m)**
528.033	9.732	2033.05	9.873	2040.684	9.964	2032.086	9.81
528.036	9.732	2033.045	9.873	2040.697	9.964	2032.088	9.81
527.914	9.526	2032.924	9.695	2040.528	9.796	2031.936	9.634
525.868	9.522	2031.456	9.649	2038.476	9.787	2029.884	9.623
524.627	9.486	2029.609	9.639	2036.257	9.76	2027.749	9.614
523.203	9.468	2028.674	9.631	2034.285	9.717	2025.594	9.604
522.027	9.437	2028.18	9.633	2032.069	9.66	2024.066	9.636
521.845	9.486	2027.76	9.569	2030.632	9.609	2023.429	9.674
520.7	9.491	2027.47	9.564	2029.797	9.63	2022.838	9.724
519.943	9.407	2026.903	9.583	2028.647	9.565	2021.708	9.706
518.848	9.402	2025.873	9.549	2028.294	9.628	2020.801	9.721
517.54	9.372	2024.904	9.519	2027.442	9.546	2019.936	9.754
516.254	9.357	2024.428	9.52	2026.822	9.56	2019.326	9.785
515.88	9.171	2024.068	9.438	2026.068	9.667	2019.013	9.792
514.929	8.749	2023.422	9.416	2025.167	9.712	2018.791	9.659
514.756	8.703	2022.934	9.48	2024.629	9.663	2018.524	9.529
514.585	8.398	2022.595	9.511	2024.163	9.534	2018.364	9.332
514.496	8.053	2022.338	9.377	2023.487	9.049	2018.018	9.026
514.43	7.924	2022.051	9.14	2022.791	8.6	2017.751	8.845
514.365	7.852	2021.901	8.775	2022.146	8.319	2017.635	8.649
513.898	7.789	2021.729	8.593	2021.706	8.259	2017.19	8.412
513.275	7.852	2021.665	8.406	2020.815	8.231	2016.653	8.13
512.433	7.901	2021.55	8.292	2019.62	8.156	2015.987	7.828
511.153	7.861	2021.224	8.206	2018.308	8.046	2015.53	7.742
510.178	7.789	2020.812	8.266	2017.246	8.002	2015.195	7.779
509.653	7.818	2020.251	8.203	2015.882	7.971	2014.629	8.023
509.416	7.768	2019.863	8.109	2014.925	7.949	2014.075	7.945
509.151	7.832	2019.01	8.083	2014.662	7.926	2012.931	7.917
508.745	7.778	2017.592	8.02	2014.031	8.223	2012.025	7.984
508.29	7.941	2016.538	7.982	2013.297	8.591	2010.804	8.016
508.015	8.2	2015.617	7.984	2013.087	8.788	2009.889	8.036
507.637	8.486	2014.887	8.065	2012.91	9.046	2009.339	8.104
507.315	8.643	2014.383	8.275	2012.409	9.24	2008.937	8.292
507.067	8.959	2014.164	8.528	2012.013	9.391	2008.68	8.419
506.856	9.076	2013.971	8.785	2011.549	9.625	2008.599	8.622
506.568	9.347	2013.816	8.874	2011.15	9.798	2008.278	9.182
506.312	9.39	2013.611	8.915	2010.243	9.933	2007.991	9.371
506.205	9.514	2013.429	9.11	2008.905	9.926	2007.831	9.542
505.827	9.599	2013.068	9.333	2007.016	9.867	2007.579	9.693

Upper Swift Creek cross sections 4 to 7 2004							
UM04 Distance (m)	**18-Aug-04 Assumed Height (m)**	**UM05 Distance (m)**	**9-Sep-04 Assumed Height (m)**	**UM06 Distance (m)**	**9-Sep-04 Assumed Height (m)**	**UM07 Distance (m)**	**9-Sep-04 Assumed Height (m)**
505.408	9.632	2012.597	9.432	2005.379	9.856	2007.003	9.716
503.458	9.65	2012.441	9.473	2003.973	9.841	2005.716	9.753
502.266	9.688	2012.08	9.68	2002.239	9.813	2004.338	9.767
501.315	9.747	2011.773	9.806			2003.106	9.803
		2011.275	9.834			2001.859	9.788
		2010.387	9.84				
		2009.145	9.814				
		2007.915	9.811				
		2006.717	9.833				
		2005.413	9.814				
		2003.998	9.819				
		2002.234	9.819				

Swift Creek Cross sections 1 to 4 2004							
SM01 Distance (m)	**9-Sep-04 Assumed Height (m)**	**SM02 Distance (m)**	**9-Sep-04 Assumed Height (m)**	**SM03 Distance (m)**	**9-Sep-04 Assumed Height (m)**	**SM04 Distance (m)**	**8-Sep-04 Assumed Height (m)**
462.58	9.05	2037.788	8.02	2040.659	8.045	2033.253	7.963
462.563	9.05	2037.787	8.021	2040.656	8.045	2033.245	7.963
462.734	8.834	2037.645	7.843	2040.548	7.905	2033.083	7.78
464.577	8.79	2035.924	7.865	2040.527	7.905	2030.784	7.801
466.726	8.753	2034.885	7.902	2038.439	7.92	2029.036	7.849
468.265	8.744	2033.215	7.932	2036.582	7.894	2027.17	7.93
469.113	8.614	2031.063	7.945	2034.352	7.861	2025.593	7.966
469.771	8.572	2029.637	7.941	2032.517	7.791	2025.109	7.988
470.681	8.55	2029.35	7.903	2031.763	7.638	2024.662	7.851
471.386	8.527	2028.751	7.798	2031.173	7.547	2024.367	7.53
471.877	8.492	2028.267	7.684	2030.953	7.497	2024.142	7.443
472.699	8.29	2027.677	7.568	2030.687	7.417	2023.887	7.171
473.391	8.143	2027.114	7.547	2030.321	7.381	2023.762	7.03
473.719	8.012	2026.677	7.484	2030.11	7.173	2023.443	6.929
473.897	7.925	2026.438	7.343	2029.749	7.063	2023.161	6.778
474.14	7.761	2026.025	7.288	2029.369	6.935	2022.914	6.715
474.328	7.631	2025.665	7.107	2029.179	6.795	2022.833	6.453
474.612	7.519	2025.176	6.933	2028.812	6.807	2022.631	6.383
474.806	7.381	2024.834	6.749	2027.843	6.722	2022.481	6.123
475.562	7.364	2024.667	6.65	2026.993	6.705	2021.139	6.174
476.84	7.293	2024.205	6.622	2025.98	6.663	2019.306	6.253
477.642	7.211	2023.72	6.639	2025.227	6.623	2017.698	6.292
478.454	7.221	2022.322	6.631	2024.027	6.503	2016.091	6.388
479.362	7.152	2021.437	6.614	2023.372	6.361	2014.487	6.435
480.052	7.142	2020.885	6.434	2022.109	6.299	2013.703	6.511
480.634	7.545	2020.234	6.32	2020.824	6.224	2013.221	6.902
481.202	7.722	2019.909	6.233	2019.577	6.107	2012.99	7.242
481.444	7.91	2019.08	6.229	2018.759	6.012	2012.508	7.386
481.688	8.014	2018.539	6.414	2018.265	6.218	2011.744	7.479
482.122	8.222	2017.982	6.41	2017.677	6.553	2011.171	7.514
482.66	8.45	2017.5	6.344	2017.022	6.695	2010.813	7.487
483.154	8.656	2017.301	6.167	2016.558	6.775	2010.239	7.579
483.872	8.982	2016.87	6.036	2015.903	6.76	2009.407	7.648
485.571	9.017	2016.403	6	2015.471	6.771	2007.681	7.736
488.085	8.973	2015.822	6.048	2014.96	6.749	2005.097	7.813
490.559	8.924	2015.355	6.128	2014.546	6.829	2002.225	7.804
492.616	8.905	2014.851	6.171	2014.554	6.843		
494.452	8.873	2014.391	6.275	2014.283	6.974		
495.693	8.884	2014.083	6.341	2014.021	7.186		

Swift Creek Cross sections 1 to 4 2004							
SM01 Distance (m)	**9-Sep-04 Assumed Height (m)**	**SM02 Distance (m)**	**9-Sep-04 Assumed Height (m)**	**SM03 Distance (m)**	**9-Sep-04 Assumed Height (m)**	**SM04 Distance (m)**	**8-Sep-04 Assumed Height (m)**
496.068	8.942	2013.698	6.483	2013.608	7.336		
496.259	8.797	2013.442	6.646	2013.126	7.475		
496.75	8.732	2013.157	6.625	2012.532	7.572		
497.175	8.911	2012.42	6.645	2011.571	7.627		
498.161	8.832	2011.74	6.627	2010.157	7.556		
		2011.212	6.686	2009.094	7.472		
		2010.716	6.802	2008.209	7.469		
		2009.995	6.904	2007.144	7.504		
		2009.261	7.05	2005.944	7.53		
		2008.527	7.235	2004.425	7.595		
		2007.742	7.414	2002.588	7.724		
		2007.098	7.548				
		2005.866	7.627				
		2004.791	7.722				
		2003.653	7.754				
		2001.929	7.797				

Swift Creek Cross sections 5 to 8 2004							
SM05 Distance (m)	**9-Sep-04 Assumed Height (m)**	**SM06 Distance (m)**	**9-Sep-04 Assumed Height (m)**	**SM07 Distance (m)**	**8-Sep-04 Assumed Height (m)**	**SM08 Distance (m)**	**8-Sep-04 Assumed Height (m)**
2082.683	8	2047.876	7.781	2060.664	7.703	2052.954	7.85
2082.691	8	2047.867	7.781	2060.647	7.704	2052.952	7.85
2082.517	7.791	2047.69	7.599	2060.484	7.522	2052.816	7.664
2080.603	7.79	2044.135	7.603	2056.7	7.59	2049.939	7.672
2078.76	7.789	2040.612	7.645	2053.958	7.646	2046.315	7.698
2076.147	7.853	2037.143	7.696	2050.71	7.663	2043.38	7.7
2073.892	7.931	2034.288	7.736	2045.798	7.782	2041.521	7.713
2071.745	7.963	2032.465	7.743	2042.814	7.88	2039.941	7.782
2070.503	7.951	2031.286	7.655	2041.202	7.907	2038.306	7.76
2069.848	7.867	2030.68	7.52	2040.549	7.839	2037.681	7.675
2069.27	7.616	2030.071	7.342	2040.169	7.681	2036.959	7.622
2068.81	7.301	2029.595	7.194	2040.048	7.573	2036.436	7.623
2068.328	7.072	2029.261	7.022	2039.895	7.283	2035.542	7.517
2068.081	6.872	2028.932	6.842	2039.744	6.995	2034.857	7.333
2067.673	6.587	2028.575	6.687	2039.47	6.964	2034.655	7.223
2067.499	6.485	2028.355	6.51	2039.298	6.757	2034.432	7.175
2067.437	6.312	2027.999	6.323	2038.943	6.547	2034.135	6.986
2067.141	5.927	2027.728	6.087	2038.529	6.243	2033.927	6.751
2066.815	5.933	2027.381	6.039	2038.36	6.057	2033.439	6.535
2066.139	6.027	2026.018	6.025	2037.458	6.093	2032.64	6.394
2065.164	6.154	2024.141	6.105	2035.903	6.168	2031.543	6.355
2063.505	6.185	2022.449	6.157	2034.559	6.301	2030.331	6.296
2061.544	6.228	2021.235	6.184	2032.876	6.388	2028.99	6.231
2059.651	6.213	2020.938	6.122	2031.098	6.554	2028.047	6.152
2058.456	6.189	2020.712	6.365	2029.802	6.657	2026.954	6.179
2058.188	6.282	2020.476	6.416	2029.081	6.698	2025.754	6.125
2057.989	6.417	2020.23	6.614	2028.355	6.757	2024.718	6.112
2057.373	6.489	2020.008	6.775	2027.97	7.002	2024.213	6.07
2056.977	6.607	2019.245	6.876	2027.674	7.323	2023.625	6.417
2056.45	6.717	2018.64	7.009	2027.248	7.522	2022.708	6.696
2055.573	6.894	2018.049	7.149	2026.549	7.655	2022.577	6.966
2054.992	7.097	2017.662	7.257	2025.979	7.705	2022.133	7.186
2054.262	7.182	2017.576	7.332	2025.551	7.786	2021.515	7.256
2053.366	7.254	2016.47	7.508	2023.702	7.816	2021.14	7.23
2052.975	7.269	2015.161	7.678	2021.491	7.74	2020.915	7.301
2052.497	7.417	2013.79	7.707	2019.194	7.694	2020.456	7.305
2051.741	7.452	2011.633	7.727	2016.097	7.71	2019.927	7.331
2050.993	7.589	2009.254	7.705	2013.169	7.741	2019.403	7.507
2049.952	7.699	2007.043	7.714	2009.845	7.818	2018.929	7.598

Swift Creek Cross sections 5 to 8 2004							
SM05 Distance (m)	**9-Sep-04 Assumed Height (m)**	**SM06 Distance (m)**	**9-Sep-04 Assumed Height (m)**	**SM07 Distance (m)**	**8-Sep-04 Assumed Height (m)**	**SM08 Distance (m)**	**8-Sep-04 Assumed Height (m)**
2048.539	7.693	2004.682	7.743	2006.322	7.857	2018.162	7.811
2046.357	7.744	2002.182	7.807	2002.787	7.832	2016.974	7.91
2043.915	7.736					2015.171	7.911
2041.28	7.714					2013.011	7.808
2038.153	7.723					2010.902	7.733
2034.954	7.67					2009.109	7.709
2032.673	7.613					2006.758	7.739
2030.404	7.587					2004.199	7.758
2028.578	7.504					2001.855	7.782
2026.814	7.418						
2025.123	7.285						
2024.244	7.063						
2023.4	6.808						
2022.684	6.698						
2021.687	6.659						
2020.576	6.682						
2018.903	6.87						
2017.108	7.057						
2015.393	7.279						
2012.949	7.501						
2010.226	7.594						
2008.061	7.616						
2005.881	7.693						
2003.922	7.77						

Appendix B

Cumulative frequency grain size distributions for bulk bed material collected in 2004. The cumulative frequency distributions are shown separately for Tributary North main gully and Tributary North tributary gully in Tables B1 & B2. The location of the cross sections where the bulk bed material samples were collected are shown in the relevant sections in the text. The following tables are included in Appendix B:

Table B1 – 2004: Tributary North main gully data

Table B2 – 2004: Tributary North tributary gully data

Table B3 – 2004: Tributary Central data

Table B4 – 2004: East Tributary data

Table B5 – 2004: Upper Swift Creek data

Table B6 – 2004: Swift Creek data

Table B1 Cumulative frequency grain size distributions for bulk bed material samples on the main gully of Tributary North for 2004

Sample	TN01	Gravel Mass = 35.15 g	
Date	18-Aug-04	Remaining Mass = 836.74 g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	35.15	4.03
-0.5	1.4 mm	2.38	6.03
0.0	1.0 mm	6.80	9.75
0.5	710 µm	15.12	16.74
1.0	500 µm	34.28	32.85
1.5	355 µm	52.63	48.28
2.0	250 µm	70.47	63.28
2.5	180 µm	85.43	75.85
3.0	125 µm	93.72	82.82
3.5	90 µm	97.88	86.32
4.0	63 µm	99.44	87.63
8.0	<63 µm	114.15	100.00

Folk (1974) Texture Group: Slightly granular muddy medium sand

Sample	TN03	Gravel Mass = 77.97 g	
Date	18-Aug-04	Remaining Mass = 1534.25 g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	77.97	4.84
-0.5	1.4 mm	3.89	8.22
0.0	1.0 mm	7.91	11.71
0.5	710 µm	14.7	17.62
1.0	500 µm	32.03	32.69
1.5	355 µm	54.70	52.41
2.0	250 µm	78.89	73.44
2.5	180 µm	93.47	86.12
3.0	125 µm	100.65	92.36
3.5	90 µm	103.29	94.66
4.0	63 µm	104.47	95.69
<4.0	<63 µm	109.43	100.00

Folk (1974) Texture Group: Slightly granular medium sand

Sample	TN02	Gravel Mass = 6.00 g	
Date	17-Aug-04	Remaining Mass =1041.34 g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	6.00	0.57
-0.5	1.4 mm	2.15	2.61
0.0	1.0 mm	8.73	8.85
0.5	710 µm	24.02	23.35
1.0	500 µm	54.54	52.30
1.5	355 µm	80.40	76.82
2.0	250 µm	97.77	93.30
2.5	180 µm	101.49	96.82
3.0	125 µm	102.16	97.46
3.5	90 µm	102.36	97.65
4.0	63 µm	102.48	97.76
<4.0	<63 µm	104.84	100.00

Folk (1974) Texture Group: Slightly granular coarse sand

Sample	TN04	Gravel Mass = 78.14 g	
Date	17-Aug-04	Remaining Mass =1168.93 g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm	19.13	1.53
-1.5	2.4 mm	61.96	4.97
-1.0	2.0 mm	78.14	6.27
-0.5	1.4 mm	3.85	9.47
0.0	1.0 mm	9.09	13.82
0.5	710 µm	18.89	21.97
1.0	500 µm	45.73	44.29
1.5	355 µm	75.15	68.75
2.0	250 µm	95.32	85.52
2.5	180 µm	103.68	92.47
3.0	125 µm	107.62	95.75
3.5	90 µm	109.05	96.94
4.0	63 µm	109.75	97.52
<4.0	<63 µm	112.73	100.00

Folk (1974) Texture Group: Granular medium sand

Table B1 Cumulative frequency grain size distributions for bulk bed material samples on the main gully of Tributary North for 2004 (Continued)

Sample	TN06	Gravel Mass = 24.28 g	
Date	17-Aug-04	Remaining Mass = 1440.08 g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	24.28	0.80
-0.5	1.4 mm	1.13	1.81
0.0	1.0 mm	4.30	4.64
0.5	710 µm	11.99	11.49
1.0	500 µm	35.05	32.05
1.5	355 µm	61.49	55.63
2.0	250 µm	81.21	73.21
2.5	180 µm	90.48	81.47
3.0	125 µm	95.88	86.29
3.5	90 µm	98.52	88.64
4.0	63 µm	100.58	90.48
8.0	<63 µm	111.26	100.00

Folk (1974) Texture Group: Slightly granular medium sand

Sample	TN08	Gravel Mass = 63.53 g	
Date	17-Aug-04	Remaining Mass = 1516.39 g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	63.53	4.02
-0.5	1.4 mm	6.36	9.85
0.0	1.0 mm	13.82	16.69
0.5	710 µm	24.55	26.52
1.0	500 µm	48.32	48.30
1.5	355 µm	72.59	70.54
2.0	250 µm	89.08	85.65
2.5	180 µm	95.77	91.78
3.0	125 µm	99.44	95.14
3.5	90 µm	101.00	96.57
4.0	63 µm	101.79	97.30
<4.0	<63 µm	104.74	100.00

Folk (1974) Texture Group: slightly granular medium sand

Sample	TN07	Gravel Mass = 24.53 g	
Date	17-Aug-04	Remaining Mass = 1179.83 g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	24.53	2.04
-0.5	1.4 mm	0.75	2.74
0.0	1.0 mm	3.09	4.94
0.5	710 µm	9.85	11.29
1.0	500 µm	30.20	30.42
1.5	355 µm	57.00	55.60
2.0	250 µm	83.39	80.40
2.5	180 µm	95.95	92.20
3.0	125 µm	99.87	95.88
3.5	90 µm	101.10	97.04
4.0	63 µm	101.58	97.49
<4.0	<63 µm	104.25	100.00

Folk (1974) Texture Group: Slightly granular medium sand

Sample	TN09	Gravel Mass = 29.11 g	
Date	17-Aug-04	Remaining Mass = 1002.02 g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	29.11	2.82
-0.5	1.4 mm	2.57	5.13
0.0	1.0 mm	6.96	9.08
0.5	710 µm	15.04	16.33
1.0	500 µm	36.19	35.33
1.5	355 µm	60.93	57.56
2.0	250 µm	81.99	76.47
2.5	180 µm	93.19	86.53
3.0	125 µm	99.78	92.45
3.5	90 µm	102.42	94.83
4.0	63 µm	103.77	96.04
<4.0	<63 µm	108.18	100.00

Folk (1974) Texture Group: Slightly granular medium sand

Table B2 Cumulative frequency grain size distributions for bulk bed material samples on the tributary gully of Tributary North for 2004

Sample	TN05 Trib	Gravel Mass = 6.59 g	
Date	17-Aug-04	Remaining Mass = 814.38 g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	6.59	0.80
-0.5	1.4 mm	1.13	1.81
0.0	1.0 mm	4.30	4.64
0.5	710 µm	11.99	11.49
1.0	500 µm	35.05	32.05
1.5	355 µm	61.49	55.63
2.0	250 µm	81.21	73.21
2.5	180 µm	90.48	81.47
3.0	125 µm	95.88	86.29
3.5	90 µm	98.52	88.64
4.0	63 µm	100.58	90.48
8.0	<63 µm	111.26	100.00

Folk (1974) Texture Group: Slightly granular medium sand

Sample	TN06 Trib	Gravel Mass = 6.02 g	
Date	17-Aug-04	Remaining Mass = 1299.9 g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	6.02	0.46
-0.5	1.4 mm	1.26	1.69
0.0	1.0 mm	4.97	5.30
0.5	710 µm	14.83	14.91
1.0	500 µm	39.81	39.25
1.5	355 µm	64.49	63.29
2.0	250 µm	83.78	82.08
2.5	180 µm	89.83	87.98
3.0	125 µm	91.73	89.83
3.5	90 µm	92.67	90.74
4.0	63 µm	93.33	91.39
8.0	<63 µm	102.17	100.00

Folk (1974) Texture Group: Slightly granular medium sand

Sample	TN04 Trib	Gravel Mass = 4.50 g	
Date	17-Aug-04	Remaining Mass = 1017.27 g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	4.50	0.44
-0.5	1.4 mm	1.25	1.52
0.0	1.0 mm	4.75	4.56
0.5	710 µm	12.83	11.56
1.0	500 µm	38.50	33.81
1.5	355 µm	66.28	57.89
2.0	250 µm	87.50	76.28
2.5	180 µm	97.74	85.16
3.0	125 µm	103.67	90.30
3.5	90 µm	105.91	92.24
4.0	63 µm	107.12	93.29
4.5	<63 µm	114.86	100.00

Folk (1974) Texture Group: Slightly granular medium sand

Sample	TN07 Trib	Gravel Mass = 13.47 g	
Date	17-Aug-04	Remaining Mass = 868.33 g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	13.47	1.53
-0.5	1.4 mm	1.01	2.47
0.0	1.0 mm	3.15	4.46
0.5	710 µm	8.69	9.63
1.0	500 µm	24.66	24.51
1.5	355 µm	51.16	49.22
2.0	250 µm	80.97	77.00
2.5	180 µm	93.93	89.08
3.0	125 µm	98.06	92.93
3.5	90 µm	99.74	94.50
4.0	63 µm	100.64	95.34
<4.0	<63 µm	105.64	100.00

Folk (1974) Texture Group: Slightly granular medium sand

Table B2 Cumulative frequency grain size distributions for bulk bed material samples on the tributary gully of Tributary North for 2004 (Continued)

Sample	**TN08 Trib**	**Gravel Mass = 105.72 g**	
Date	**17-Aug-04**	**Remaining Mass = 861.64 g**	
Phi		**Mass (g)**	**Cumulative %**
-2.0	**4.0 mm**	45.77	4.73
-1.5	**2.4 mm**	91.63	9.47
-1.0	**2.0 mm**	105.72	10.93
-0.5	**1.4 mm**	3.54	13.93
0.0	**1.0 mm**	7.30	17.11
0.5	**710 µm**	14.05	22.83
1.0	**500 µm**	30.07	36.40
1.5	**355 µm**	50.49	53.69
2.0	**250 µm**	76.46	75.69
2.5	**180 µm**	92.78	89.51
3.0	**125 µm**	98.90	94.70
3.5	**90 µm**	100.96	96.44
4.0	**63 µm**	101.74	97.10
<4.0	**<63 µm**	105.16	100.00

Folk (1974) Texture Group: Granular medium sand

Table B3 Cumulative frequency grain size distributions for bulk bed material samples on Tributary Central for 2004

Sample	TC06A	Gravel Mass = 23.74 g	
Date	8-Sep-04	Remaining Mass = 1305.14 g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	23.74	1.79
-0.5	1.4 mm	1.34	3.05
0.0	1.0 mm	4.47	6.01
0.5	710 µm	12.40	13.50
1.0	500 µm	37.95	37.64
1.5	355 µm	70.80	68.68
2.0	250 µm	93.06	89.71
2.5	180 µm	99.76	96.04
3.0	125 µm	101.37	97.56
3.5	90 µm	101.64	97.82
4.0	63 µm	101.74	97.91
<4.0	<63 µm	103.95	100.00

Folk (1974) Texture Group: Slightly granular medium sand

Sample	TC06C	Gravel Mass = 65.97 g	
Date	8-Sep-04	Remaining Mass = 1398.27 g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	65.97	4.72
-0.5	1.4 mm	3.61	7.97
0.0	1.0 mm	9.09	12.90
0.5	710 µm	18.02	20.93
1.0	500 µm	38.19	39.08
1.5	355 µm	64.74	62.97
2.0	250 µm	90.34	86.00
2.5	180 µm	100.12	94.80
3.0	125 µm	102.71	97.13
3.5	90 µm	103.17	97.54
4.0	63 µm	103.33	97.69
<4.0	<63 µm	105.90	100.00

Folk (1974) Texture Group: Slightly granular medium sand

Sample	TC06B	Gravel Mass = 74.89 g	
Date	8-Sep-04	Remaining Mass = 1268.81 g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm	28.71	2.14
-1.5	2.4 mm	60.30	4.49
-1.0	2.0 mm	74.89	5.57
-0.5	1.4 mm	3.39	8.67
0.0	1.0 mm	8.99	13.79
0.5	710 µm	20.20	24.04
1.0	500 µm	45.96	47.59
1.5	355 µm	73.24	72.54
2.0	250 µm	94.52	91.99
2.5	180 µm	99.61	96.64
3.0	125 µm	100.67	97.61
3.5	90 µm	100.92	97.84
4.0	63 µm	101.02	97.93
<4.0	<63 µm	103.28	100.00

Folk (1974) Texture Group: Granular medium sand

Sample	TC07A	Gravel Mass = 651.48 g	
Date	8-Sep-04	Remaining Mass = 832.8 g	
Phi		Mass (g)	Cumulative %
-4.0	16.0 mm	224.84	15.15
-3.25	9.5 mm	449.61	30.29
-2.0	4.0 mm	590.46	39.78
-1.5	2.4 mm	636.72	42.90
-1.0	2.0 mm	651.48	43.89
-0.5	1.4 mm	3.47	45.71
0.0	1.0 mm	7.54	47.83
0.5	710 µm	14.28	51.35
1.0	500 µm	32.23	60.73
1.5	355 µm	60.42	75.47
2.0	250 µm	86.15	88.91
2.5	180 µm	96.56	94.35
3.0	125 µm	101.10	96.72
3.5	90 µm	102.39	97.40
4.0	63 µm	102.89	97.66
<4.0	<63 µm	107.37	100.00

Folk (1974) Texture Group: Medium sandy pebble gravel

Table B3 Cumulative frequency grain size distributions for bulk bed material samples on Tributary Central for 2004 (Continued)

Sample	TC07B	Gravel Mass = 643.85 g	
Date	8-Sep-04	Remaining Mass = 985.9 g	
Phi		Mass (g)	Cumulative %
-5	32.0 mm	0.00	0.00
-4.0	16.0 mm	121.59	7.46
-3.25	9.5 mm	296.27	18.18
-2.0	4.0 mm	519.73	31.89
-1.5	2.4 mm	616.76	37.84
-1.0	2.0 mm	643.85	39.51
-0.5	1.4 mm	6.51	43.16
0.0	1.0 mm	13.49	47.09
0.5	710 µm	23.08	52.47
1.0	500 µm	39.81	61.88
1.5	355 µm	58.76	72.52
2.0	250 µm	82.07	85.62
2.5	180 µm	95.66	93.26
3.0	125 µm	100.45	95.95
3.5	90 µm	101.96	96.80
4.0	63 µm	102.51	97.11
<4.0	<63 µm	107.66	100.00

Folk (1974) Texture Group: Medium sandy pebble gravel

Sample	TC07C	Gravel Mass = 182.44 g	
Date	8-Sep-04	Remaining Mass = 1066.14 g	
Phi		Mass (g)	Cumulative %
-6	64 mm	0.00	0.00
-5	32 mm	64.86	5.19
-4	16 mm	81.15	6.50
-3.25	9.5 mm	102.03	8.17
-2.0	4.0 mm	143.14	11.46
-1.5	2.4 mm	172.17	13.79
-1.0	2.0 mm	182.44	14.61
-0.5	1.4 mm	2.56	16.68
0.0	1.0 mm	5.98	19.44
0.5	710 µm	11.61	23.99
1.0	500 µm	25.57	35.27
1.5	355 µm	46.70	52.33
2.0	250 µm	71.79	72.60
2.5	180 µm	85.68	83.82
3.0	125 µm	93.16	89.86
3.5	90 µm	96.19	92.31
4.0	63 µm	97.89	93.68
4.5	<63 µm	105.71	100.00

Folk (1974) Texture Group: Pebbly medium sand

Table B3 Cumulative frequency grain size distributions for bulk bed material samples on Tributary Central for 2004 (Continued)

Sample	TC08	Gravel Mass = 308.38 g	
Date	8-Sep-04	Remaining Mass = 789.35 g	
Phi		Mass (g)	Cumulative %
-5.0	32.0 mm	54.09	4.93
-4.0	16.0 mm	173.32	15.79
-3.25	9.5 mm	237.40	21.63
-2.0	4.0 mm	277.8	25.31
-1.5	2.4 mm	299.03	27.24
-1.0	2.0 mm	308.38	28.09
-0.5	1.4 mm	2.07	29.50
0.0	1.0 mm	6.29	32.37
0.5	710 µm	14.54	37.98
1.0	500 µm	32.97	50.51
1.5	355 µm	54.20	64.95
2.0	250 µm	77.42	80.74
2.5	180 µm	92.58	91.04
3.0	125 µm	98.62	95.15
3.5	90 µm	100.53	96.45
4.0	63 µm	101.13	96.86
<4.0	<63 µm	105.75	100.00

Folk (1974) Texture Group: Pebbly medium sand

Sample	TC09	Gravel Mass = 637.85 g	
Date	8-Sep-04	Remaining Mass = 887.55 g	
Phi		Mass (g)	Cumulative %
-5.0	32 mm	0.00	0.00
-4.0	16 mm	198.95	13.04
-3.25	9.5 mm	361.93	23.73
-2.0	4.0 mm	530.21	34.76
-1.5	2.4 mm	614.07	40.26
-1.0	2.0 mm	637.85	41.82
-0.5	1.4 mm	4.54	44.23
0.0	1.0 mm	9.31	46.77
0.5	710 µm	16.56	50.63
1.0	500 µm	33.10	59.43
1.5	355 µm	52.23	69.61
2.0	250 µm	73.25	80.80
2.5	180 µm	88.83	89.09
3.0	125 µm	98.98	94.50
3.5	90 µm	102.56	96.40
4.0	63 µm	103.93	97.13
<4.0	<63 µm	109.32	100.00

Folk (1974) Texture Group Medium sandy pebble gravel

Table B3 Cumulative frequency grain size distributions for bulk bed material samples on Tributary Central for 2004 (Cont)

Sample	TC10	Gravel Mass =1056.36 g	
Date	8-Sep-04	Remaining Mass = 478.71 g	
Phi		Mass (g)	Cumulative %
-6.0	63.0 mm	0.00	0.00
-5.0	32.0 mm	332.39	21.65
-4.0	16.0 mm	526.45	34.29
-3.25	9.5 mm	705.72	45.97
-2.0	4.0 mm	952.73	62.06
-1.5	2.4 mm	1037.62	67.59
-1.0	2.0 mm	1056.36	68.81
-0.5	1.4 mm	10.13	71.74
0.0	1.0 mm	19.33	74.41
0.5	710 µm	30.42	77.61
1.0	500 µm	48.22	82.76
1.5	355 µm	67.11	88.23
2.0	250 µm	88.77	94.49
2.5	180 µm	99.20	97.51
3.0	125 µm	102.64	98.50
3.5	90 µm	103.82	98.85
4.0	63 µm	104.28	98.98
<4.0	<63 µm	107.81	100.00

Folk (1974) Texture Group: Medium sandy pebble gravel

Sample	TC05	Gravel Mass = 758.51 g	
Date	8-Sep-04	Remaining Mass = 710.14 g	
Phi		Mass (g)	Cumulative %
-6.0	63.0 mm	0.00	0.00
-5.0	32.0 mm	47.15	3.21
-4.0	16.0 mm	132.75	9.04
-3.25	9.5 mm	308.72	21.02
-2.0	4.0 mm	590.93	40.24
-1.5	2.4 mm	718.93	48.95
-1.0	2.0 mm	758.51	51.65
-0.5	1.4 mm	9.16	55.93
0.0	1.0 mm	17.34	59.75
0.5	710 µm	26.08	63.83
1.0	500 µm	42.22	71.37
1.5	355 µm	62.10	80.66
2.0	250 µm	82.96	90.41
2.5	180 µm	93.88	95.51
3.0	125 µm	98.36	97.60
3.5	90 µm	99.63	98.20
4.0	63 µm	100.12	98.43
<4.0	<63 µm	103.49	100.00

Folk (1974) Texture Group: Medium sandy pebble gravel

Table B3 Cumulative frequency grain size distributions for bulk bed material samples on Tributary Central for 2004 (Cont)

Sample	TC11	Gravel Mass = 145.25 g	
Date	8-Sep-04	Remaining Mass = 1222.71g	
Phi		Mass (g)	Cumulative %
-4.0	16.0 mm	23.27	1.70
-3.25	9.5 mm	61.20	4.47
-2.0	4.0 mm	114.52	8.37
-1.5	2.4 mm	138.10	10.09
-1.0	2.0 mm	145.26	10.62
-0.5	1.4 mm	1.79	12.13
0.0	1.0 mm	3.87	13.89
0.5	710 µm	7.07	16.59
1.0	500 µm	16.88	24.87
1.5	355 µm	37.66	42.42
2.0	250 µm	71.48	70.99
2.5	180 µm	91.81	88.16
3.0	125 µm	99.73	94.85
3.5	90 µm	101.44	96.29
4.0	63 µm	101.99	96.76
<4.0	<63 µm	105.83	100.00

Folk (1974) Texture Group: Slightly pebbly medium sand

Sample	TC04	Gravel Mass = 80.95 g	
Date	8-Sep-04	Remaining Mass = 1251.57g	
Phi		Mass (g)	Cumulative %
-3.25	9.5 mm	17.64	1.32
-2.0	4.0 mm	50.84	3.82
-1.5	2.4 mm	72.61	5.45
-1.0	2.0 mm	80.95	6.07
-0.5	1.4 mm	2.55	8.36
0.0	1.0 mm	6.92	12.29
0.5	710 µm	15.60	20.07
1.0	500 µm	33.12	35.80
1.5	355 µm	53.01	53.65
2.0	250 µm	74.90	73.29
2.5	180 µm	87.48	84.58
3.0	125 µm	93.31	89.81
3.5	90 µm	96.14	92.35
4.0	63 µm	97.36	93.45
<4.0	<63 µm	104.66	100.00

Folk (1974) Texture Group: Slightly pebbly medium sand

Sample	TC03	Gravel Mass = 37.66 g	
Date	8-Sep-04	Remaining Mass = 945.39 g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	37.66	3.83
-0.5	1.4 mm	3.97	7.43
0.0	1.0 mm	11.80	14.54
0.5	710 µm	25.18	26.68
1.0	500 µm	49.57	48.81
1.5	355 µm	73.39	70.43
2.0	250 µm	93.31	88.50
2.5	180 µm	100.91	95.40
3.0	125 µm	102.92	97.22
3.5	90 µm	103.48	97.73
4.0	63 µm	103.70	97.93
<4.0	<63 µm	105.98	100.00

Folk (1974) Texture Group: Slightly granular medium sand

Sample	TC01	Gravel Mass = 317.86 g	
Date	8-Sep-04	Remaining Mass = 666.76 g	
Phi		Mass (g)	Cumulative %
-4.0	16.0 mm	48.35	4.91
-3.25	9.5 mm	139.89	14.21
-2.0	4.0 mm	249.32	25.32
-1.5	2.4 mm	303.42	30.82
-1.0	2.0 mm	317.86	32.28
-0.5	1.4 mm	4.30	35.02
0.0	1.0 mm	9.86	38.56
0.5	710 µm	18.87	44.29
1.0	500 µm	36.62	55.59
1.5	355 µm	56.95	68.53
2.0	250 µm	79.25	82.73
2.5	180 µm	92.26	91.01
3.0	125 µm	97.13	94.11
3.5	90 µm	98.91	95.24
4.0	63 µm	99.63	95.70
<4.0	<63 µm	106.38	100.00

Folk (1974) Texture Group: Medium sandy pebble gravel

Table B4 Cumulative frequency grain size distributions for bulk bed material samples on East Tributary for 2004

Sample	ET01	Gravel Mass = 7.37g	
Date	9-Sep-04	Remaining Mass = 1380.67g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	7.37	0.53
-0.5	1.4 mm	0.99	1.46
0.0	1.0 mm	4.41	4.69
0.5	710 µm	13.93	13.67
1.0	500 µm	43.07	41.17
1.5	355 µm	76.36	72.57
2.0	250 µm	98.59	93.55
2.5	180 µm	104.33	98.96
3.0	125 µm	105.27	99.85
3.5	90 µm	105.37	99.94
4.0	63 µm	105.41	99.98
<4.0	<63 µm	105.43	100.00

Folk (1974) Texture Group: Slightly granular medium sand

Sample	ET02	Gravel Mass = 82.05g	
Date	9-Sep-04	Remaining Mass = 1685.58g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	82.05	4.64
-0.5	1.4 mm	3.73	7.96
0.0	1.0 mm	8.87	12.54
0.5	710 µm	17.44	20.16
1.0	500 µm	39.32	39.64
1.5	355 µm	68.34	65.47
2.0	250 µm	93.03	87.44
2.5	180 µm	103.62	96.87
3.0	125 µm	106.70	99.61
3.5	90 µm	107.04	99.91
4.0	63 µm	107.10	99.96
<4.0	<63 µm	107.14	100.00

Folk (1974) Texture Group: Slightly granular medium sand

Sample	ET03	Gravel Mass = 186.86g	
Date	9-Sep-04	Remaining Mass = 1324.39g	
Phi		Mass (g)	Cumulative %
-3.25	9.5 mm	5.96	0.39
-2.0	4.0 mm	86.91	5.75
-1.5	2.4 mm	160.40	10.61
-1.0	2.0 mm	186.86	12.36
-0.5	1.4 mm	5.39	16.87
0.0	1.0 mm	12.05	22.43
0.5	710 µm	22.11	30.83
1.0	500 µm	47.29	51.85
1.5	355 µm	74.59	74.65
2.0	250 µm	94.38	91.17
2.5	180 µm	102.31	97.80
3.0	125 µm	104.58	99.69
3.5	90 µm	104.86	99.92
4.0	63 µm	104.91	99.97
<4.0	<63 µm	104.95	100.00

Folk (1974) Texture Group: Granular medium sand

Sample	ET04	Gravel Mass = 242.39g	
Date	9-Sep-04	Remaining Mass = 1033.5g	
Phi		Mass (g)	Cumulative %
-3.25	9.5 mm	2.01	0.16
-2.0	4.0 mm	68.33	5.36
-1.5	2.4 mm	200.43	15.71
-1.0	2.0 mm	242.39	19.00
-0.5	1.4 mm	12.67	28.76
0.0	1.0 mm	23.20	36.88
0.5	710 µm	35.18	46.11
1.0	500 µm	56.47	62.52
1.5	355 µm	75.25	76.99
2.0	250 µm	91.31	89.37
2.5	180 µm	100.73	96.62
3.0	125 µm	104.00	99.14
3.5	90 µm	104.75	99.72
4.0	63 µm	104.96	99.88
<4.0	<63 µm	105.11	100.00

Folk (1974) Texture Group: Granular coarse sand

Table B4 Cumulative frequency grain size distributions for bulk bed material samples on East Tributary for 2004 (Continued)

Sample	ET05	Gravel Mass = 62.49g	
Date	9-Sep-04	Remaining Mass = 1020.27g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm	9.7	0.90
-1.5	2.4 mm	42.86	3.96
-1.0	2.0 mm	62.49	5.77
-0.5	1.4 mm	6.33	11.35
0.0	1.0 mm	15.69	19.59
0.5	710 µm	29.67	31.90
1.0	500 µm	61.45	59.89
1.5	355 µm	89.10	84.24
2.0	250 µm	103.11	96.58
2.5	180 µm	106.32	99.41
3.0	125 µm	106.91	99.93
3.5	90 µm	106.96	99.97
4.0	63 µm	106.98	99.99
<4.0	<63 µm	106.99	100.00

Folk (1974) Texture Group: Granular coarse sand

Sample	ET06	Gravel Mass = 90.12g	
Date	9-Sep-04	Remaining Mass = 1110.39g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm	21.46	1.79
-1.5	2.4 mm	64.02	5.33
-1.0	2.0 mm	90.12	7.51
-0.5	1.4 mm	5.17	12.12
0.0	1.0 mm	13.41	19.46
0.5	710 µm	25.70	30.42
1.0	500 µm	52.98	54.74
1.5	355 µm	79.38	78.28
2.0	250 µm	98.24	95.10
2.5	180 µm	102.94	99.29
3.0	125 µm	103.64	99.91
3.5	90 µm	103.72	99.98
4.0	63 µm	103.73	99.99
<4.0	<63 µm	103.74	100.00

Folk (1974) Texture Group: Granular coarse sand

Sample	ET07	Gravel Mass = 62.79g	
Date	9-Sep-04	Remaining Mass = 1390.97g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	62.79	4.32
-0.5	1.4 mm	5.21	9.06
0.0	1.0 mm	11.60	14.87
0.5	710 µm	20.64	23.09
1.0	500 µm	42.55	43.01
1.5	355 µm	67.77	65.94
2.0	250 µm	88.44	84.73
2.5	180 µm	98.64	94.01
3.0	125 µm	103.78	98.68
3.5	90 µm	104.95	99.75
4.0	63 µm	105.18	99.95
<4.0	<63 µm	105.23	100.00

Folk (1974) Texture Group: Slightly granular medium sand

Sample	ET08	Gravel Mass = 288.28g	
Date	9-Sep-04	Remaining Mass = 1715.95g	
Phi		Mass (g)	Cumulative %
-3.25	9.5 mm	3.22	0.16
-2.0	4.0 mm	100.29	5.00
-1.5	2.4 mm	231.11	11.53
-1.0	2.0 mm	288.28	14.38
-0.5	1.4 mm	9.01	21.83
0.0	1.0 mm	19.27	30.30
0.5	710 µm	33.06	41.69
1.0	500 µm	57.37	61.78
1.5	355 µm	78.44	79.18
2.0	250 µm	94.32	92.30
2.5	180 µm	101.08	97.89
3.0	125 µm	103.12	99.57
3.5	90 µm	103.52	99.90
4.0	63 µm	103.60	99.97
<4.0	<63 µm	103.64	100.00

Folk (1974) Texture Group: Granular coarse sand

Table B5 Cumulative frequency grain size distributions for bulk bed material samples on upper Swift Creek for 2004

Sample	UM01	Gravel Mass = 4.53g	
Date	18-Aug-04	Remaining Mass = 784.07g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	4.53	0.57
-0.5	1.4 mm	0.33	0.87
0.0	1.0 mm	1.16	1.60
0.5	710 µm	4.25	4.34
1.0	500 µm	20.19	18.47
1.5	355 µm	50.34	45.18
2.0	250 µm	86.00	76.78
2.5	180 µm	104.97	93.59
3.0	125 µm	111.25	99.16
3.5	90 µm	112.07	99.88
4.0	63 µm	112.18	99.98
<4.0	<63 µm	112.20	100.00

Folk (1974) Texture Group: Slightly granular medium sand

Sample	UM03	Gravel Mass = 34.74	
Date	18-Aug-04	Remaining Mass = 1394.85g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	34.74	2.43
-0.5	1.4 mm	4.97	6.97
0.0	1.0 mm	14.38	15.56
0.5	710 µm	30.49	30.26
1.0	500 µm	58.14	55.50
1.5	355 µm	82.44	77.67
2.0	250 µm	100.13	93.82
2.5	180 µm	105.55	98.77
3.0	125 µm	106.76	99.87
3.5	90 µm	106.87	99.97
4.0	63 µm	106.89	99.99
<4.0	<63 µm	106.90	100.00

Folk (1974) Texture Group: Slightly granular coarse sand

Sample	UM02	Gravel Mass = 112.54g	
Date	18-Aug-04	Remaining Mass = 1831.98g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm	22.38	1.15
-1.5	2.4 mm	86.93	4.47
-1.0	2.0 mm	112.54	5.79
-0.5	1.4 mm	5.62	10.46
0.0	1.0 mm	13.75	17.22
0.5	710 µm	28.96	29.86
1.0	500 µm	65.51	60.25
1.5	355 µm	93.84	83.80
2.0	250 µm	107.58	95.23
2.5	180 µm	111.96	98.87
3.0	125 µm	113.16	99.87
3.5	90 µm	113.28	99.97
4.0	63 µm	113.31	99.99
<4.0	<63 µm	113.32	100.00

Folk (1974) Texture Group: Slightly granular coarse sand

Sample	UMGW	Gravel Mass = 24.51 g	
Date	18-Aug-04	Remaining Mass = 1690.78g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	24.51	1.43
-0.5	1.4 mm	2.37	3.46
0.0	1.0 mm	7.66	8.00
0.5	710 µm	22.05	20.35
1.0	500 µm	55.96	49.45
1.5	355 µm	84.75	74.15
2.0	250 µm	106.32	92.66
2.5	180 µm	113.62	98.93
3.0	125 µm	114.75	99.90
3.5	90 µm	114.83	99.97
4.0	63 µm	114.86	99.99
<4.0	<63 µm	114.87	100.00

Folk (1974) Texture Group: Slightly granular medium sand

Table B5 Cumulative frequency grain size distributions for bulk bed material samples on upper Swift Creek for 2004(Continued)

Sample	UM04	Gravel Mass = 93.38g	
Date	18-Aug-04	Remaining Mass = 1520.79g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm	18.66	1.16
-1.5	2.4 mm	71.63	4.44
-1.0	2.0 mm	93.38	5.79
-0.5	1.4 mm	4.28	9.65
0.0	1.0 mm	10.98	15.70
0.5	710 µm	24.84	28.21
1.0	500 µm	53.83	54.39
1.5	355 µm	79.58	77.64
2.0	250 µm	97.03	93.39
2.5	180 µm	102.74	98.55
3.0	125 µm	104.21	99.87
3.5	90 µm	104.32	99.97
4.0	63 µm	104.34	99.99
<4.0	<63 µm	104.35	100.00

Folk (1974) Texture Group: Granular medium sand

Sample	UM06	Gravel Mass = 55.45g	
Date	9-Sep-04	Remaining Mass = 1781.25g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	55.45	3.02
-0.5	1.4 mm	1.99	4.85
0.0	1.0 mm	7.09	9.54
0.5	710 µm	20.48	21.86
1.0	500 µm	52.67	51.49
1.5	355 µm	81.43	77.95
2.0	250 µm	99.66	94.73
2.5	180 µm	104.39	99.08
3.0	125 µm	105.25	99.87
3.5	90 µm	105.37	99.98
4.0	63 µm	105.38	99.99
<4.0	<63 µm	105.39	100.00

Folk (1974) Texture Group: Slightly granular medium sand

Sample	UM08	Gravel Mass = 81.12g	
Date	9-Sep-04	Remaining Mass = 1612.21g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	81.12	4.79
-0.5	1.4 mm	3.74	8.05
0.0	1.0 mm	9.68	13.21
0.5	710 µm	20.75	22.85
1.0	500 µm	52.52	50.49
1.5	355 µm	85.71	79.38
2.0	250 µm	103.30	94.68
2.5	180 µm	107.93	98.71
3.0	125 µm	109.22	99.83
3.5	90 µm	109.37	99.97
4.0	63 µm	109.40	99.99
<4.0	<63 µm	109.41	100.00

Folk (1974) Texture Group: Slightly granular medium sand

Sample	UM07	Gravel Mass = 44.59g	
Date	9-Sep-04	Remaining Mass = 1524.76g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	44.59	2.84
-0.5	1.4 mm	2.75	5.37
0.0	1.0 mm	8.90	11.02
0.5	710 µm	24.88	25.72
1.0	500 µm	65.06	62.66
1.5	355 µm	91.16	86.65
2.0	250 µm	102.14	96.75
2.5	180 µm	104.88	99.26
3.0	125 µm	105.54	99.87
3.5	90 µm	105.64	99.96
4.0	63 µm	105.67	99.99
<4.0	<63 µm	105.68	100.00

Folk (1974) Texture Group: Slightly granular coarse sand

Table B6 Cumulative frequency grain size distributions for bulk bed material samples on Swift Creek for 2004

Sample	SM05	Gravel Mass = 73.30 g	
Date	9-Sep-04	Remaining Mass = 2519.83g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	73.30	2.83
-0.5	1.4 mm	3.11	5.63
0.0	1.0 mm	9.75	11.61
0.5	710 µm	22.41	23.01
1.0	500 µm	49.75	47.63
1.5	355 µm	76.22	71.46
2.0	250 µm	97.79	90.89
2.5	180 µm	105.96	98.24
3.0	125 µm	107.64	99.76
3.5	90 µm	107.85	99.95
4.0	63 µm	107.89	99.98
<4.0	<63 µm	107.91	100.00

Folk (1974) Texture Group: Slightly granular medium sand

Sample	SM02	Gravel Mass = 61.47 g	
Date	9-Sep-04	Remaining Mass = 1886.62g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	61.47	3.16
-0.5	1.4 mm	1.89	4.87
0.0	1.0 mm	4.45	7.19
0.5	710 µm	9.82	12.07
1.0	500 µm	29.99	30.37
1.5	355 µm	62.31	59.69
2.0	250 µm	91.32	86.02
2.5	180 µm	103.46	97.03
3.0	125 µm	106.38	99.68
3.5	90 µm	106.68	99.95
4.0	63 µm	106.71	99.98
<4.0	<63 µm	106.73	100.00

Folk (1974) Texture Group: Slightly granular medium sand

Sample	SM03	Gravel Mass = 49.84 g	
Date	9-Sep-04	Remaining Mass = 2426.35g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	49.84	2.01
-0.5	1.4 mm	3.76	5.46
0.0	1.0 mm	11.02	12.13
0.5	710 µm	26.25	26.11
1.0	500 µm	56.39	53.77
1.5	355 µm	82.6	77.83
2.0	250 µm	101.96	95.59
2.5	180 µm	106.23	99.51
3.0	125 µm	106.69	99.94
3.5	90 µm	106.74	99.98
4.0	63 µm	106.75	99.99
<4.0	<63 µm	106.76	100.00

Folk (1974) Texture Group: Slightly granular coarse sand

Sample	SM01	Gravel Mass = 105.37 g	
Date	9-Sep-04	Remaining Mass =1913.52 g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm	7.05	0.35
-1.5	2.4 mm	79.18	3.92
-1.0	2.0 mm	105.37	5.22
-0.5	1.4 mm	4.67	9.32
0.0	1.0 mm	12.9	16.55
0.5	710 µm	27.35	29.25
1.0	500 µm	54.78	53.34
1.5	355 µm	80.87	76.26
2.0	250 µm	101.79	94.64
2.5	180 µm	107.17	99.37
3.0	125 µm	107.80	99.92
3.5	90 µm	107.86	99.97
4.0	63 µm	107.87	99.98
<4.0	<63 µm	107.89	100.00

Folk (1974) Texture Group: Granular coarse sand

Table B6 Cumulative frequency grain size distributions for bulk bed material samples on Swift Creek for 2004 (continued)

Sample	SM06	Gravel Mass = 94.41 g	
Date	9-Sep-04	Remaining Mass = 1817.52g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	94.41	4.94
-0.5	1.4 mm	5.84	10.14
0.0	1.0 mm	14.57	17.92
0.5	710 µm	28.98	30.76
1.0	500 µm	59.65	58.10
1.5	355 µm	86.36	81.90
2.0	250 µm	102.22	96.03
2.5	180 µm	106.10	99.49
3.0	125 µm	106.60	99.94
3.5	90 µm	106.65	99.98
4.0	63 µm	106.66	99.99
<4.0	<63 µm	106.67	100.00

Folk (1974) Texture Group: Slightly granular coarse sand

Sample	SM07	Gravel Mass =63.21 g	
Date	8-Sep-04	Remaining Mass = 2129.69g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	63.21	2.88
-0.5	1.4 mm	4.28	6.80
0.0	1.0 mm	10.57	12.56
0.5	710 µm	21.30	22.38
1.0	500 µm	47.83	46.66
1.5	355 µm	76.86	73.23
2.0	250 µm	97.74	92.34
2.5	180 µm	104.46	98.49
3.0	125 µm	105.93	99.84
3.5	90 µm	106.08	99.97
4.0	63 µm	106.09	99.98
<4.0	<63 µm	106.11	100.00

Folk (1974) Texture Group: Slightly granular medium sand

Sample	SM04	Gravel Mass = 58.95 g	
Date	8-Sep-04	Remaining Mass = 2076.75g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm		
-1.5	2.4 mm		
-1.0	2.0 mm	58.95	2.76
-0.5	1.4 mm	3.68	6.12
0.0	1.0 mm	12.30	14.00
0.5	710 µm	28.42	28.73
1.0	500 µm	56.54	54.43
1.5	355 µm	79.73	75.63
2.0	250 µm	96.83	91.25
2.5	180 µm	104.45	98.22
3.0	125 µm	106.22	99.84
3.5	90 µm	106.35	99.95
4.0	63 µm	106.39	99.99
<4.0	<63 µm	106.40	100.00

Folk (1974) Texture Group: Slightly granular coarse sand

Sample	SM08	Gravel Mass = 158.99 g	
Date	8-Sep-04	Remaining Mass = 1847.1g	
Phi		Mass (g)	Cumulative %
-2.0	4.0 mm	15.07	0.75
-1.5	2.4 mm	106.15	5.29
-1.0	2.0 mm	158.99	7.93
-0.5	1.4 mm	7.26	14.12
0.0	1.0 mm	15.55	21.19
0.5	710 µm	26.16	30.23
1.0	500 µm	51.95	52.23
1.5	355 µm	80.39	76.48
2.0	250 µm	101.21	94.24
2.5	180 µm	107.00	99.17
3.0	125 µm	107.83	99.88
3.5	90 µm	107.93	99.97
4.0	63 µm	107.95	99.98
<4.0	<63 µm	107.97	100.00

Folk (1974) Texture Group: Granular medium sand