5 TECTONIC INFLUENCES ON GEOMORPHOLOGY

Morphometric analysis was conducted on a digital elevation model of the study region to examine if neotectonic features were expressed in the landscape. This involved the construction of longitudinal stream profiles and the calculation of the catchment's morphometric parameters. Information regarding the methodology involved is recorded in Chapter 2.3.

5.1 DRAINAGE ANALYSIS

The characteristics of streams and stream networks can be used as an indicator of underlying geological structures that are otherwise concealed by regolith. Stream incisions, diversions and drainage network style provide clues that can be used to reconstruct the structural geological history from the imprints left in the landscape (Holbrook & Schumm, 1999).

Figure 5.1 shows several streams in the study area that have their headwaters in the Davenport Ranges. They flow in a northeasterly direction with low channel sinuosity towards either the Neales River or Umbum Creek. Along their courses some of these streams display significant deviations from the axial trend. These changes are examined and interpreted in this chapter.

5.1.1 Neales River and Brown Creek

Suspected faults within the region have been difficult to categorise due to a lack of outcrop of pre-Quaternary geology. Alley (1993) obtained evidence of faulting along the Neales River and Brown Creek through palynological dating of Cretaceous units. Distinct age differences within the same sedimentary unit between Primrose Hill and Lagoon Hill and between the mouth of Browns Creek and the bed of the Neales River to the west infer significant movement along the lineaments defined by the Neales River channel and Browns Creek (Figure 5.1). This event postdates the Cretaceous, as the fault juxtaposes Albian and Aptian sediments. The presence of these faults beneath streambeds indicates that streams typically follow major structural lineaments within this region.

West of the Neales River, several drainage features indicate a probable fault. In this area a playa displays internal drainage characteristics rather than draining into the nearby Neales River (Figure 5.2). Streams generally flow to the northeast but are strongly diverted southeast near this playa (Figure 5.2). Other drainage within this area is similarly diverted and streams from Lambing Creek in the north to Hawker Creek in the south are collected into a common channel that delineates this structure (Figure 5.2). This lineament is aligned parallel to both the Neales River Fault and Browns Creek Fault. These drainage diversions occur within the same geological unit, the Bulldog Shale, so lithological control is not a factor. Therefore, the most likely cause for the diversion is a fault (Figure 5.2).

The pattern of drainage along Browns Creek conforms to a trellis drainage pattern that is typically associated with fractured substrates (Twidale, 2004) (Figure 5.3). In this case the trellis pattern is derived from the interaction of a longitudinal dune system almost orthogonal to the main drainage channel. Drainage collects at the base of dunes and then flows away along the dune swale parallel to the trend of the longitudinal dunes until it reaches a major channel. The main drainage channel follows a fault (Williams & Krieg, 1975) but the minor drainage channels do not follow fractures.

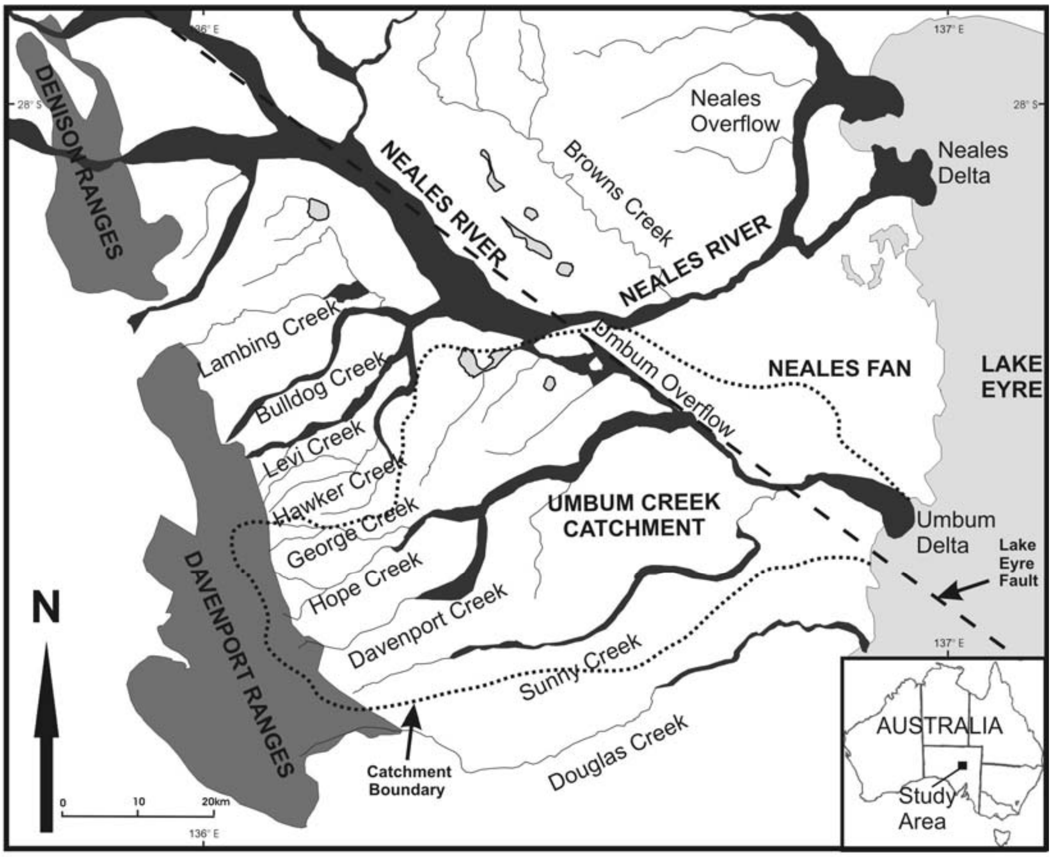


Figure 5.1: Location map showing the names and locations of tributary streams in the Umbum Creek Catchment.

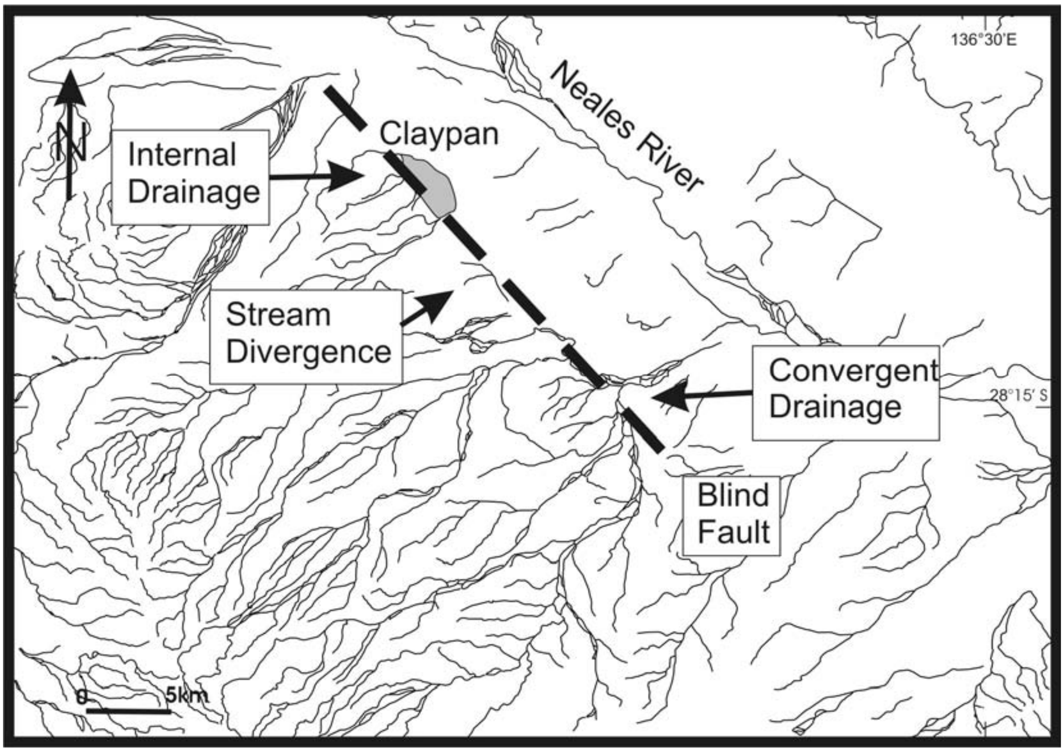


Figure 5.2: Drainage near Lambing Creek showing internal, diverted and convergent drainage related to faults.

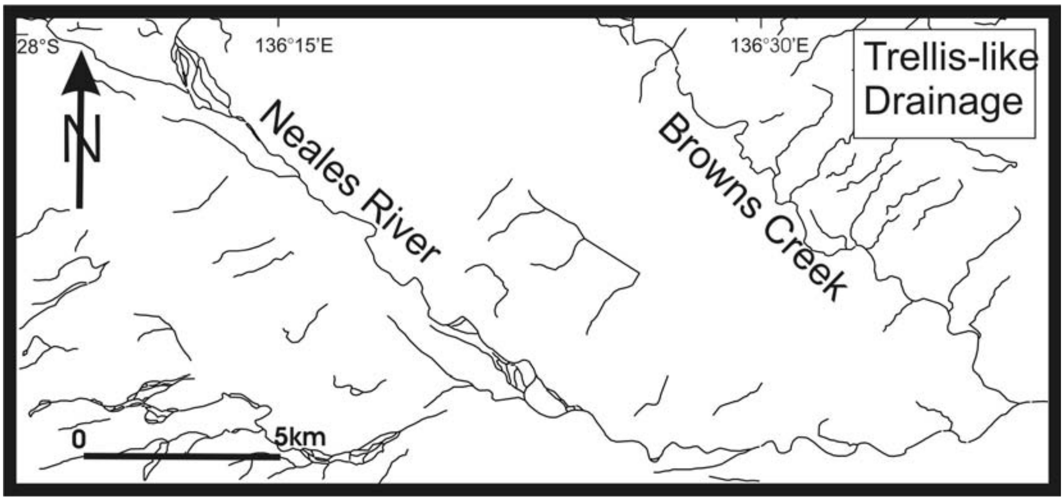


Figure 5.3: Trellis-like drainage along Browns Creek caused by drainage control from sand dunes.

5.1.2 Umbum Creek and Sunny Creek

Within an area bounded by Sunny Creek and the headwaters of Umbum Creek is a sector that displays divergent drainage in contrast to the surrounding northeasterly drainage. This region is bounded by faults on all sides and the drainage pattern is associated with headward erosion. This area appears to be a discreet structural block that has been relatively uplifted, diverting major channels around it, along fault lines, and forming minor channels within it as the area erodes (Figure 5.4).

5.1.3 Davenport Creek

Along the southern side of Davenport Creek the drainage is asymmetric with most of the drainage contributed from the south. The drainage pattern in this area is associated with an elevated ridge that forms the southern drainage divide. Given that both sides of Davenport Creek possess the same geology, this asymmetry indicates probable tectonic tilting along the northern bank of Sunny Creek (Figure 5.5).

5.1.4 Hawker Creek

A tributary to Hawker Creek winds its way through the Davenport Ranges across the Mt. Margaret Surface (Figure 5.6). The Mt. Margaret Surface is a plain of Late Jurassic origin that bevels Proterozoic sediments (Rogers & Freeman, 1996). The tributary displays well-developed meander loops of high sinuosity that are unlikely to have formed within the extremely well lithified Proterozoic sediments. It is therefore likely that this stream is inherited from an earlier phase of sedimentation, possibly associated with the Mt. Margaret Surface and originating prior to the stripping of Mesozoic sediment from the Davenport Ranges. These meander loops are incised in response to a change in base level, probably due to tectonism such as the activation of the Mt. Margaret or Levi Faults in the Plio-Pleistocene (Rogers & Freeman, 1993).

5.2 RIVER CHANNEL MORPHOLOGY

Of the river channels examined, there does not appear to be a strong correlation between the underlying structural features and the channel morphology developed on top of them. It is clear that there is a distinct separation of morphologic zones with the major area of anabranching channels occurring in the zone bounded by Lambing Creek and Hawker Creek. These anastomosing channels are associated with alluvial fans with the exception of the channels surrounding the main collector channel (Figure 5.7).

5.3 LONGITUDINAL PROFILES

Longitudinal profiles were plotted for all major tributaries in the Umbum Creek catchment. Where the channel profile deviates from the ideal, it can be inferred that something has caused this deviation. For example, a positive deviation may be the result of uplift of the rock underlying the channel or sediment aggradation (usually as the result of uplift) (Holbrook & Schumm, 1999). An examination of the profiles in Figures 5.8, 5.9 and 5.10 indicates that the profiles of channels with their headwaters in the Davenport Ranges show a positive deviation from the ideal profile in their headwaters. This is interpreted as the stream response to the uplift of the Davenport Ranges along the Mt. Margaret and Levi faults. The headwaters are actively incising into the ranges. Further downstream along these profiles a negative deviation occurs. This corresponds to zones of erosion along the base of the ranges. An example of this is the Hawker Creek profile (Figure 5.8) where a very strong negative deviation is associated with the erosional alluvial depression surrounding Hawker Springs.

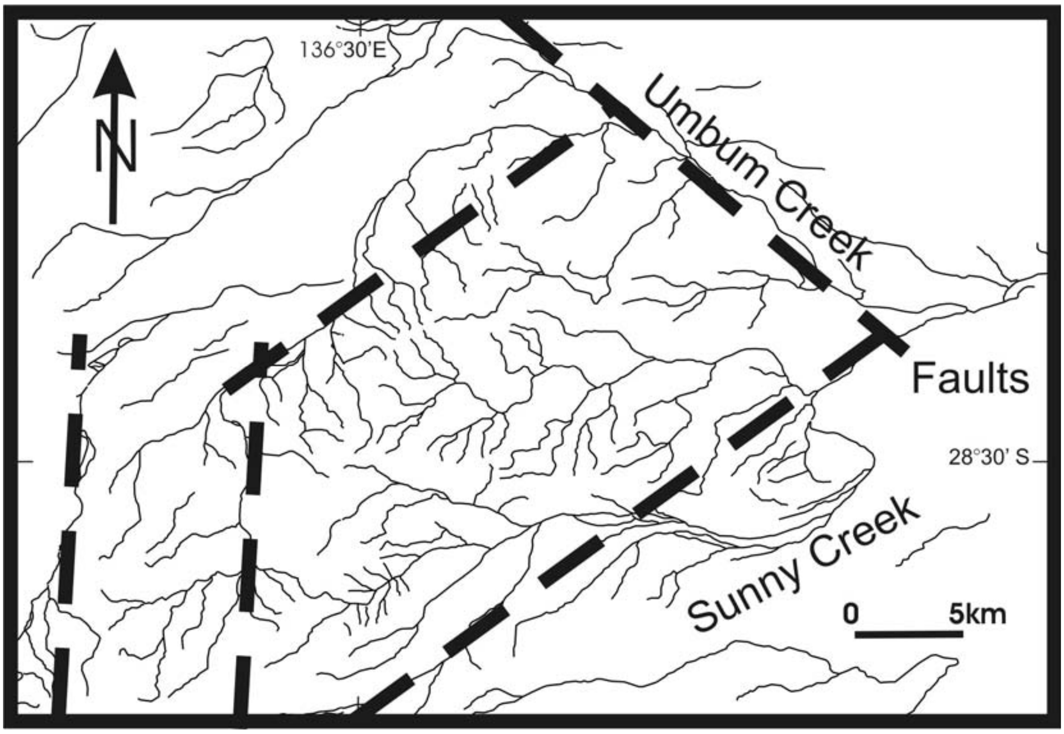


Figure 5.4: Divergent drainage between Sunny and Umbum Creeks showing the bounding faults that form the structural block.

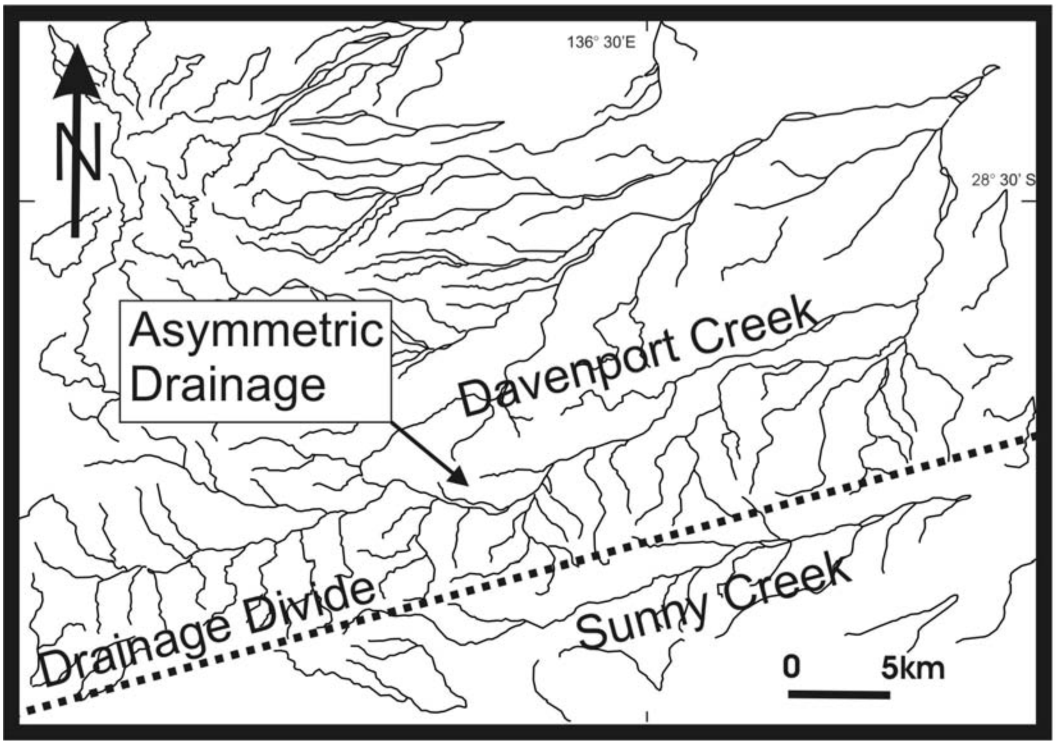


Figure 5.5: Asymmetric drainage along Davenport Creek indicating probable tectonic tilting along the axis of the valleys.

Figure 5.6: Oblique aerial photograph showing inherited meandering stream segments preserved in Proterozoic bedrock along Hawker Creek, indicating drainage antecedence prior to uplift of the ranges.

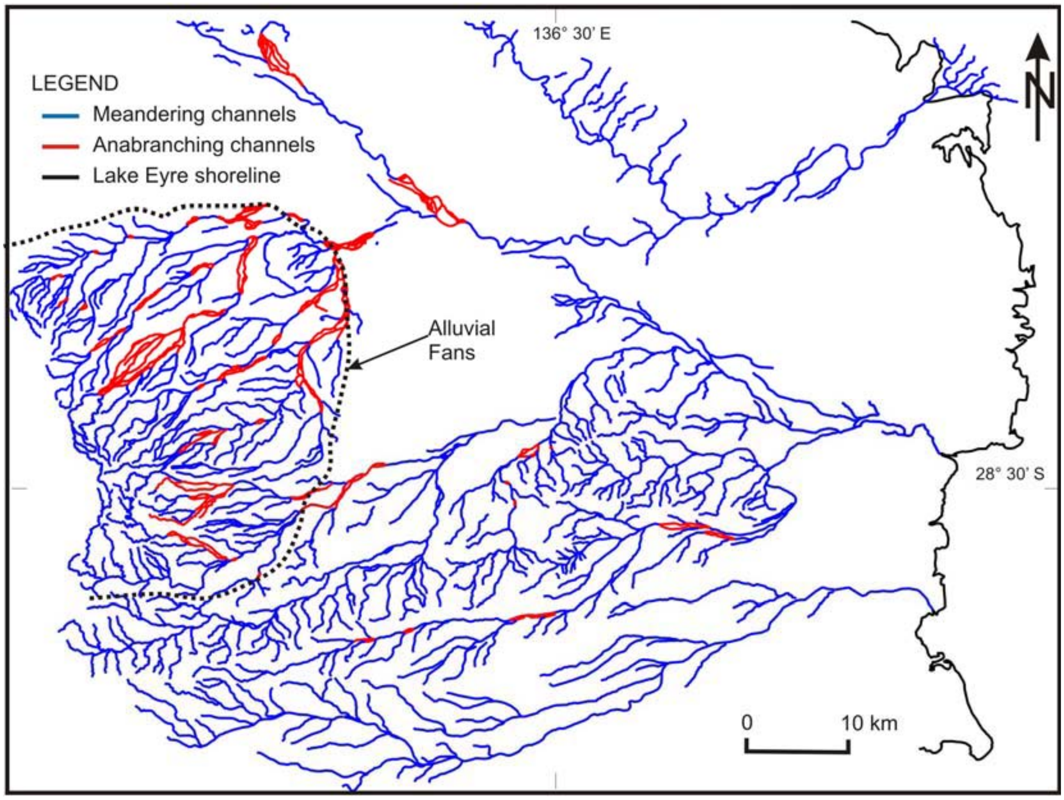


Figure 5.7: Categorised stream plan morphology showing the dominant association of anabranching channels with alluvial fans.

Lambing, Bulldog, Levi and Hawker creeks display another positive deviation further downstream (Figure 5.8). This coincides with the region of coalescing streams northwest of Lagoon Hill. This is interpreted as a zone of uplift and the channel profiles are consistent with the existence of a fault.

Sunny and Douglas creeks have longitudinal stream profiles that behave in the opposite manner to those described above (Figure 5.9). They display a negative deviation in their headwaters, a positive deviation in the middle part of the profile and a negative deviation at the stream mouth. This is interpreted as a response to uplift in the medial section of the profile where the stream is incising at a greater rate than in the headwaters and at the mouth.

It is noted that the boundaries between substrate lithologies play a role in controlling the behaviour of the stream profiles. Where streams are underlain by Proterozoic sediment they are positive, while Cretaceous sediments show very negative, and Tertiary sediment mildly negative convolutions. The extent to which channel incision is controlled by underlying strata, as opposed to tectonic movement, is unclear as fault boundaries are commonly defined by a change in substrate lithology.

An examination was made of the correlation between channel plan morphology and variation in slope along streams. Streams were divided into anabranching and meandering reaches according to their stream plan morphology (Figures 4.7 & 5.10). Areas of anabranching stream morphology were then transferred to the longitudinal stream profiles and presented as shaded boxes (Figure 5.10). No clear structural pattern emerges when comparing the location of anabranching sections across the landscape. However, landform associations are evident. Anabranching stream sections are associated, to varying degrees, with alluvial fans (Figure 5.8). The extent to which these anastomosing sections are a response to changes in channel slope is unclear, as other unmeasured factors influence channel plan morphology such as sediment particle size or vegetation colonisation.

The Neales River does display an association between in-channel slope and channel plan morphology. On the two reaches along the Neales River that are anastomosing, the downstream boundaries coincide with a break in slope that correspond to physical nick points (Figure 5.10).

5.4 SLOPE AND ASPECT

The 9 Second DEM was analysed for slope and aspect using ENVI 3.5. The study area has very low relief and thus the analysis of slope (Figure 5.11) highlights elevated features with steep slopes. Features with steep slopes occur on the banks of the Neales River adjacent to the Lake Eyre Fault and around Proterozoic inliers and topographically inverted silcretes (Figure 5.11). The Davenport Ranges have steep slopes as a result of relief caused by uplift and incision. The Mt. Margaret and Levi faults are evident as distinct linear features with steep slopes that are flanked by an area of low slope to the east associated with alluvial fans (Figure 5.11). The headwaters of Hawker and Levi creeks are deeply incised at this point and the steep slopes associated with these two channels reflect this (Figure 5.11). The higher degree of incision in Hawker Creek and Levi Creek, when compared to surrounding creeks, is interpreted as an indication of incision due to tectonic activity, probably associated with the development of the rangefront.

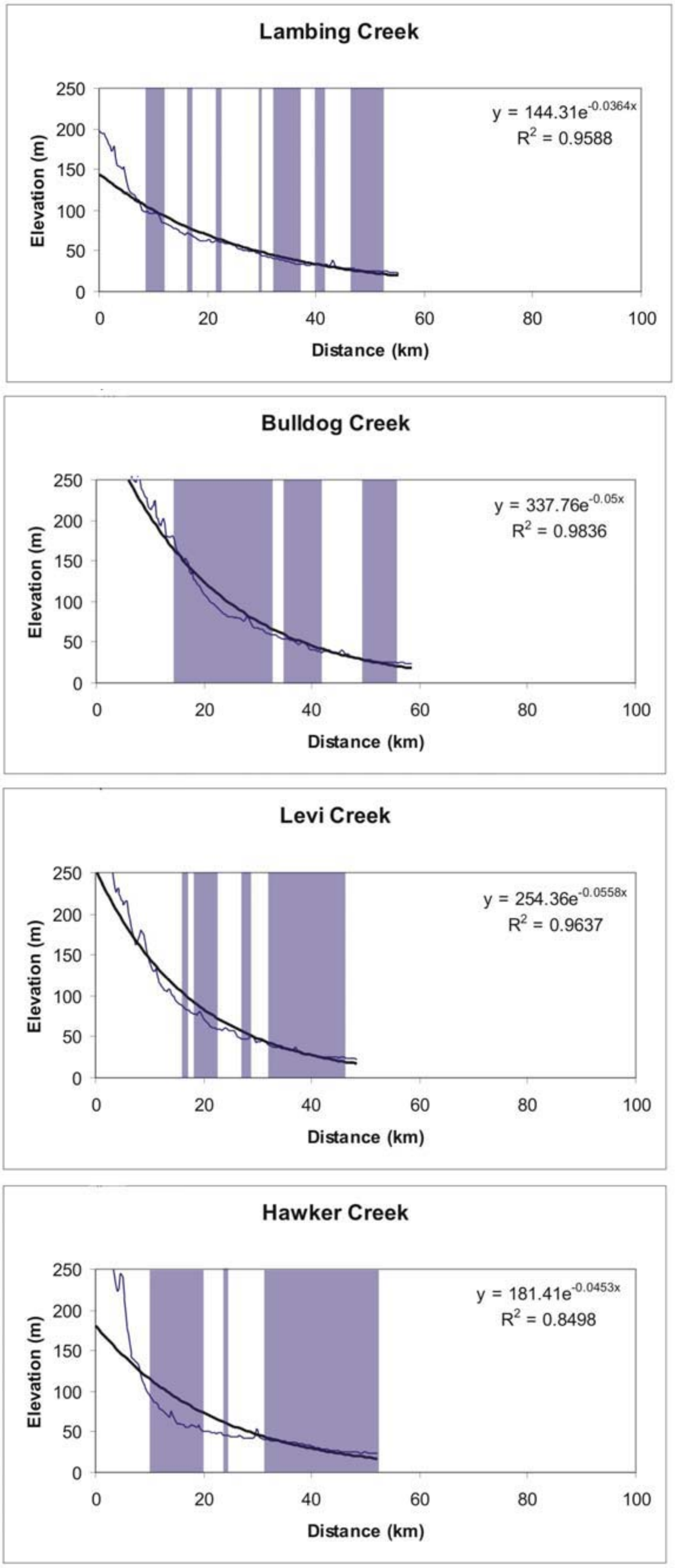
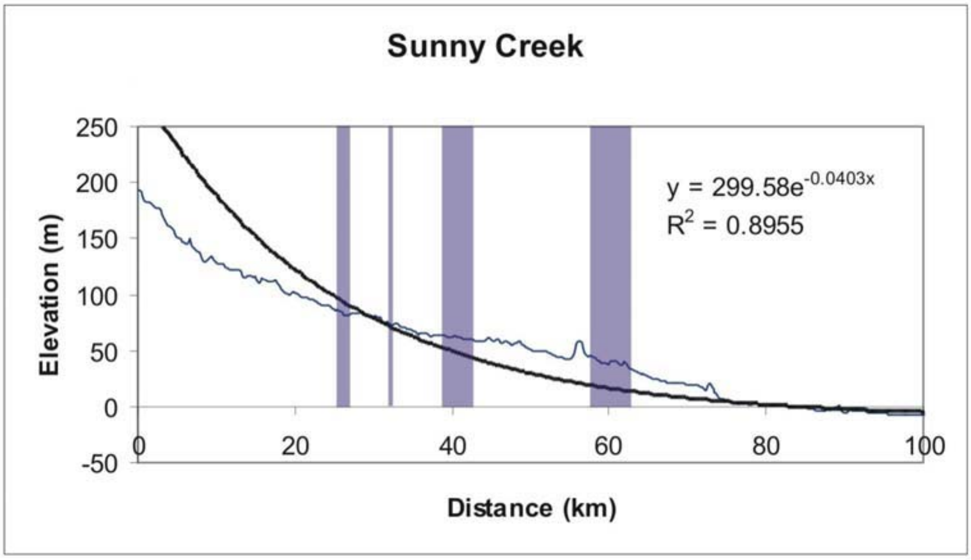


Figure 5.8: Longitudinal profiles for streams flanking the Davenport Ranges. All streams show a positive deviation in their headwaters along the rangefront, evidence of movement along the Mt. Margaret Fault. Shaded areas are anabranching reaches associated with alluvial fans.



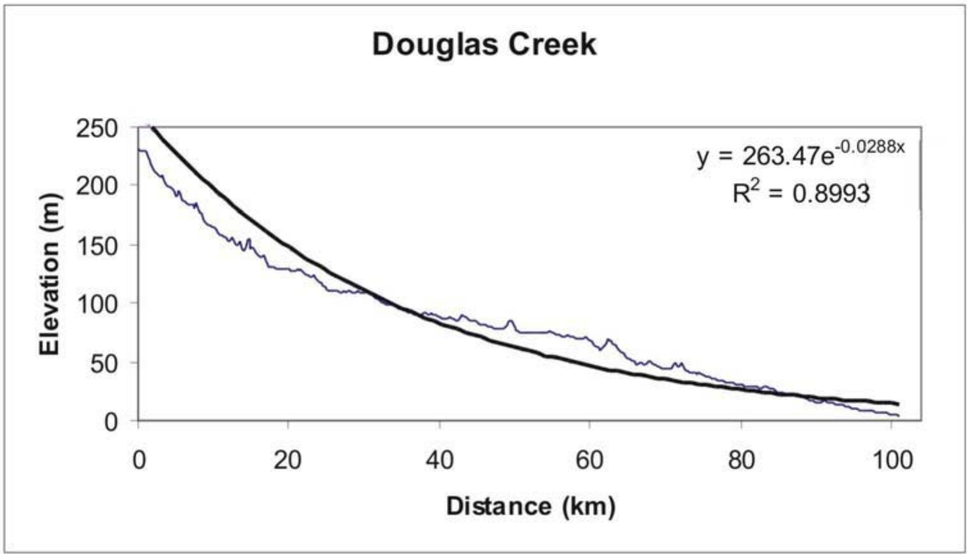


Figure 5.9: Longitudinal profile of southern streams showing a positive deviation in the medial section of each profile. This is interpreted as evidence of uplift in this zone. Shaded areas represent anabranching reaches.

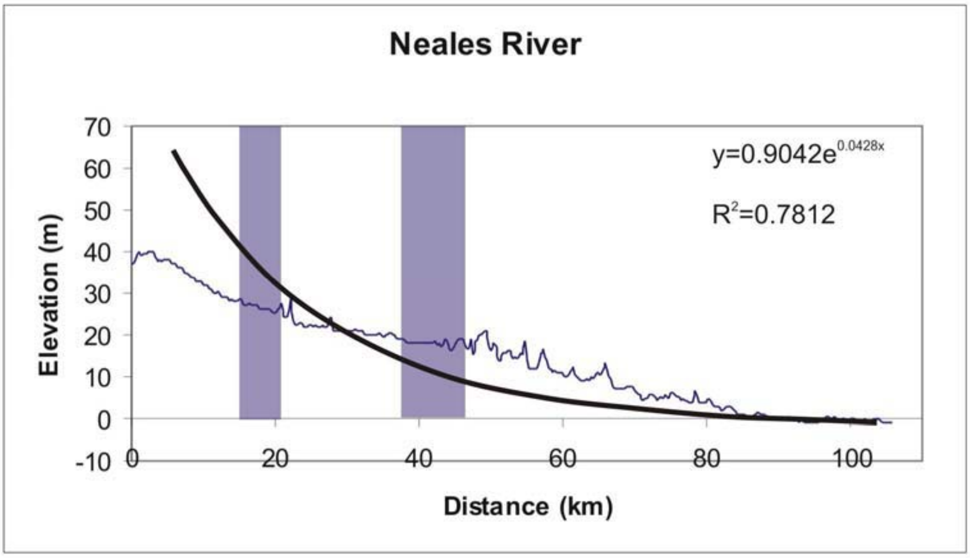


Figure 5.10: Longitudinal stream profile of the Neales River showing the location of anabranching reaches as shaded areas. The downstream boundary of each of these reaches corresponds to a change in slope and a physical nick point.

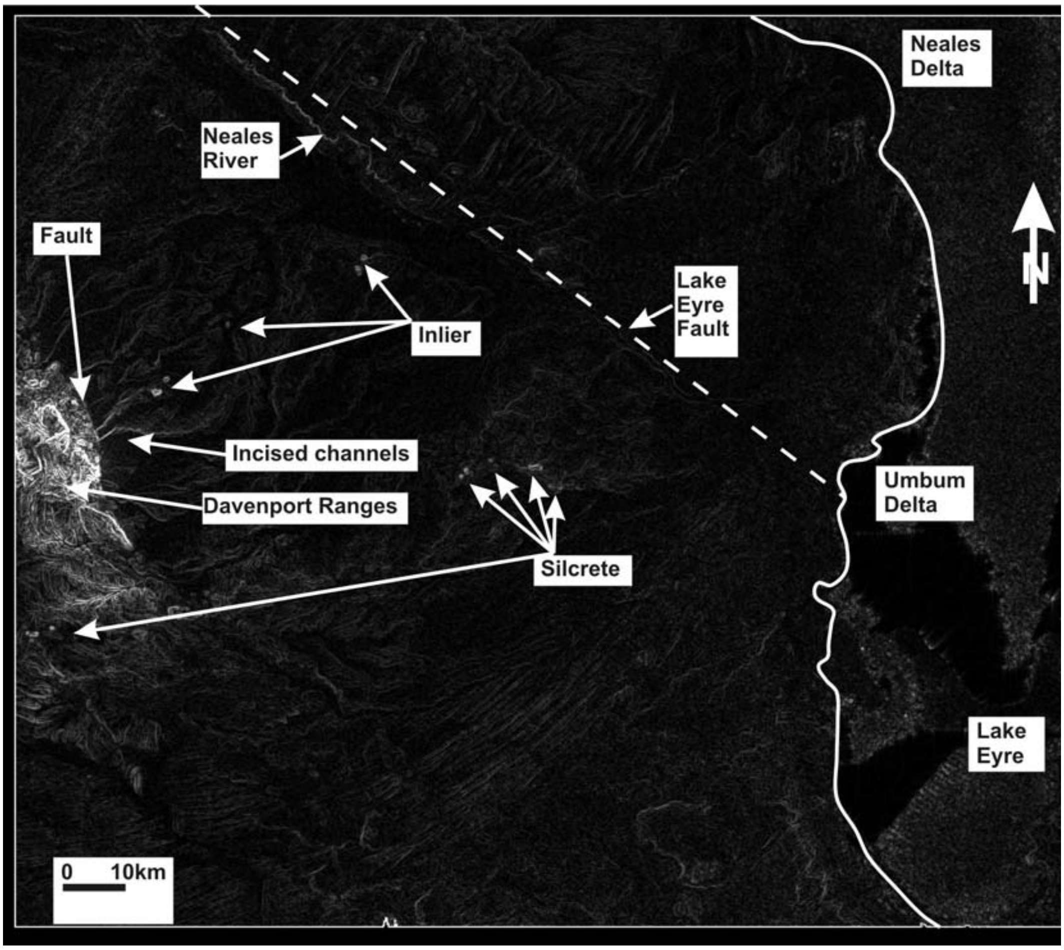


Figure 5.11: Calculated slope image for the 9 second DEM. The image is predominantly black, indicating low slopes. White areas indicate steep slopes. Proterozoic inliers and topographically inverted silcrete outcrops are prominent. The north bank of the Neales River has a steep slope and is associated with the Lake Eyre Fault. The Davenport Ranges have an escarpment on its eastern perimeter that is defined by the Levi and Mt. Margaret Faults. Movement along these faults has probably caused channel incision in Hawker and Levi creeks.

Measurements of aspect record the direction a given slope faces (Franzi, 2003). This is particularly useful in the detection of lineaments because if the lineaments are fault-related they will possess some degree of throw, which is preserved in the landscape as a slope that maintains a persistent aspect. Aside from sand dunes that display a clear two-sided aspect, two dominant trends may be observed (Figure 5.12). There is a persistent southwesterly aspect associated with the north bank of the Neales River and Umbum Overflow (Figure 5.12). There are other nearby features that display the same persistent parallel aspect. The Neales River and Umbum Overflow are interpreted as the expression of the Lake Eyre Fault and the other parallel features are interpreted as flanking faults parallel to the main Lake Eyre Fault. Other areas display discontinuous but persistent southwesterly aspect and are interpreted as evidence of minor faulting along the same trend (Figure 5.12). There is also a trend in northwesterly aspects between the Davenport Ranges and Umbum Overflow (Figure 5.12). These persistent aspect trends are interpreted to be associated with faults.

5.5 DRAINAGE DENSITY

The drainage density is calculated as the total length of drainage per unit area for a given basin (Franzi, 2003)(Table 5.1). It is an indicator of the relationship between climate, vegetation and the resistance of rock and soil to erosion. Under similar climatic conditions, impervious rocks support a higher drainage density compared to permeable rock. Semi-arid areas have higher drainage densities than arid and humid areas with the same geology because of the rapid run-off and sparse vegetation. The global range for drainage density is between 0.5 and 30 (Thornbury, 1969). The study area drainage basins display drainage densities calculated at considerably lower values than this range (Table 5.1). This is probably due to the arid climate and the development of stony surface lags that result in large volumes of unconfined overland flow rather than in the formation of channels.

Table 5.1: Summary of Morphometric Analyses.

CATCHMENT	DRAINAGE DENSITY (KM/KM^2)	HYPSOMETRIC INTEGRAL (%)	MAX. RELIEF (M)
Total	0.156	19.35	433.3
Neales	0.259	21.11	418.6
Umbum	0.2	17.58	431.26
Douglas	0.137	31.05	246.8

5.6 HYPSOMETRIC ANALYSIS

Hypsometric analysis of drainage basins within the Umbum Creek Catchment (Figure 5.13) was carried out utilising the Terrain Analysis System (TAS) freeware program applied to the 9 second DEM.

Strahler stream ordering was conducted to examine if there was an association with stream order and landform features (Figure 5.14). Analysis of the stream networks indicate that in all cases the streams conform to a normal distribution (Figures 5.15 to 5.18). Different stream orders align along a log-normal line of best fit in all cases for Average Stream Length, Average Slope and Area. The only aberration appears in the slope of third-order streams which appear slightly higher than the mean distribution. Third-order streams are generally associated with alluvial fans present on the eastern flank of the Davenport Ranges.

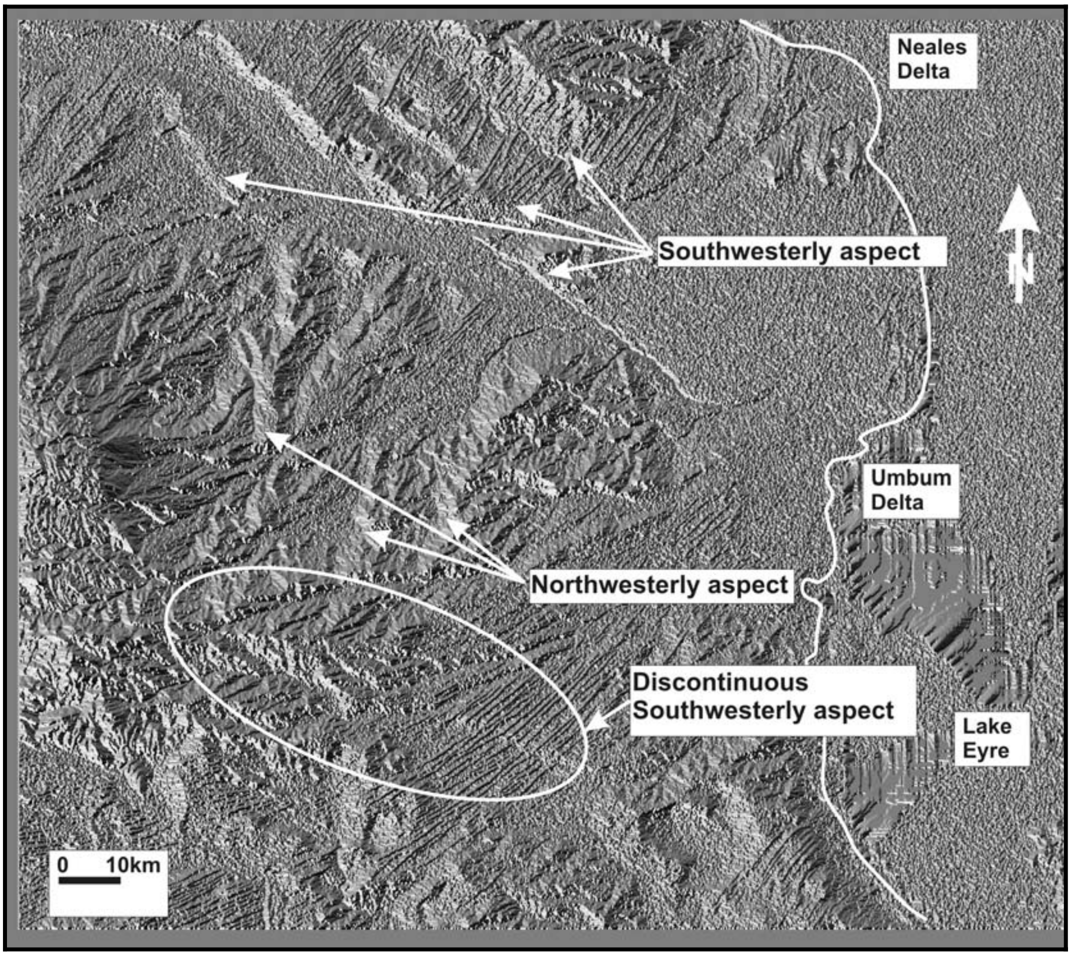


Figure 5.12: Calculated aspect image for the 9 second DEM showing two sets of aspect trends, a northwesterly trend and a southwesterly trend. These trends are probably a result of movement along underlying faults.

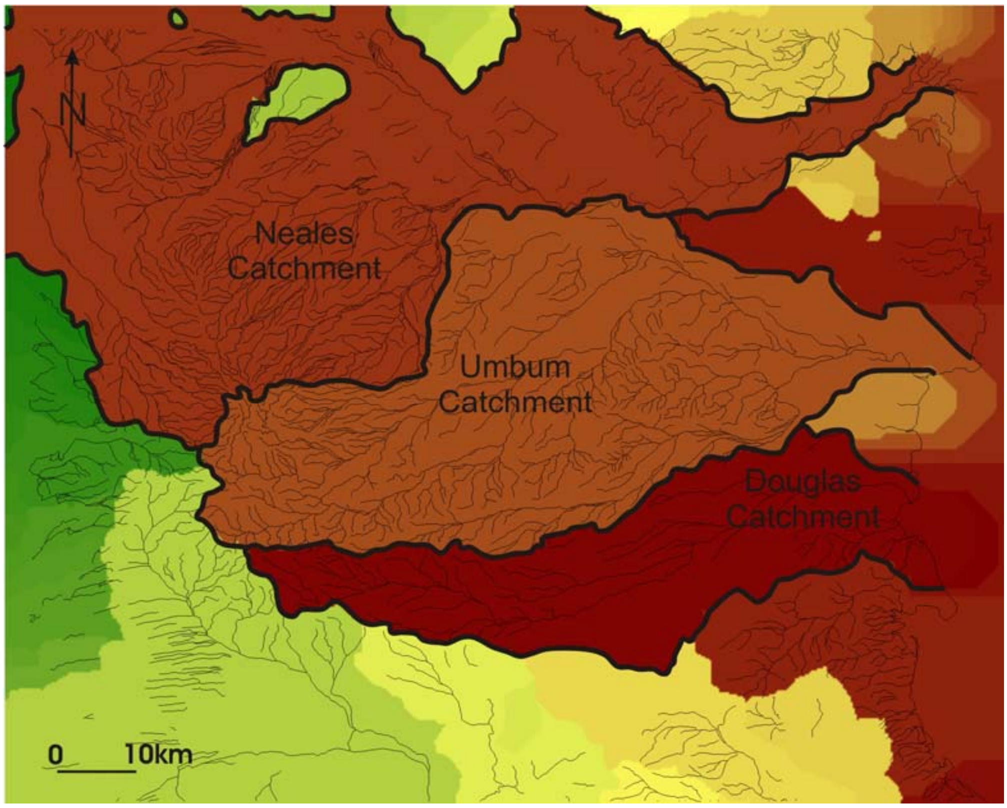


Figure 5.13: Delimitation of catchments within the study area showing the locations of catchment boundaries.

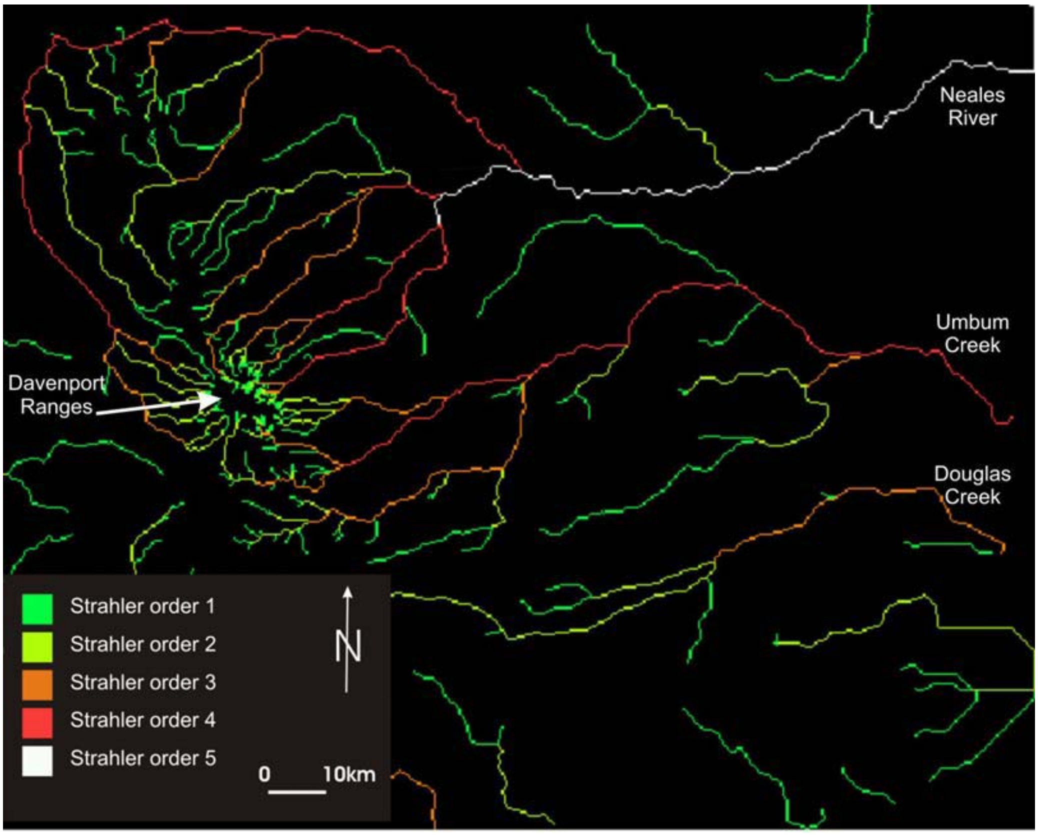
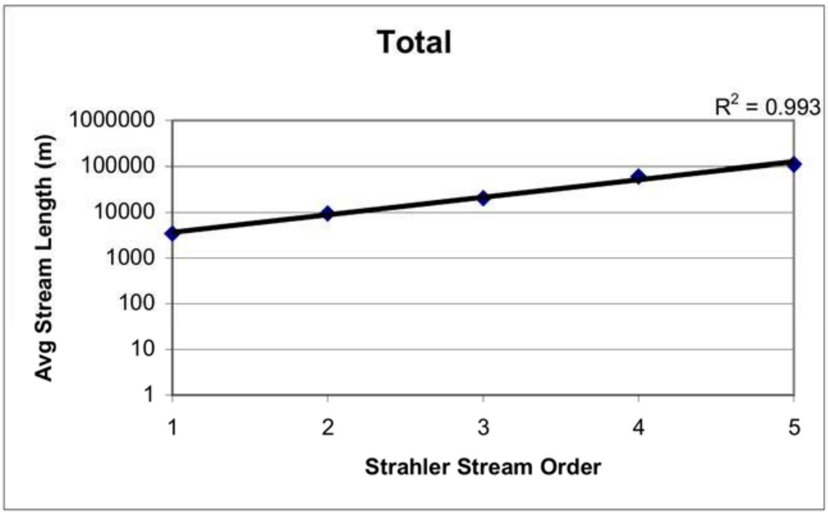
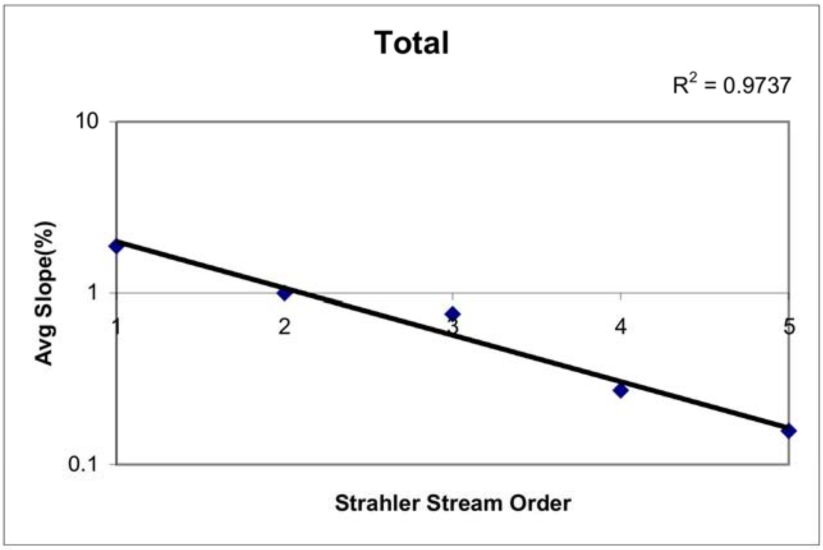


Figure 5.14: Classification results for Strahler stream ordering showing the Neales River to be the largest stream carrying the most flow in the study area.





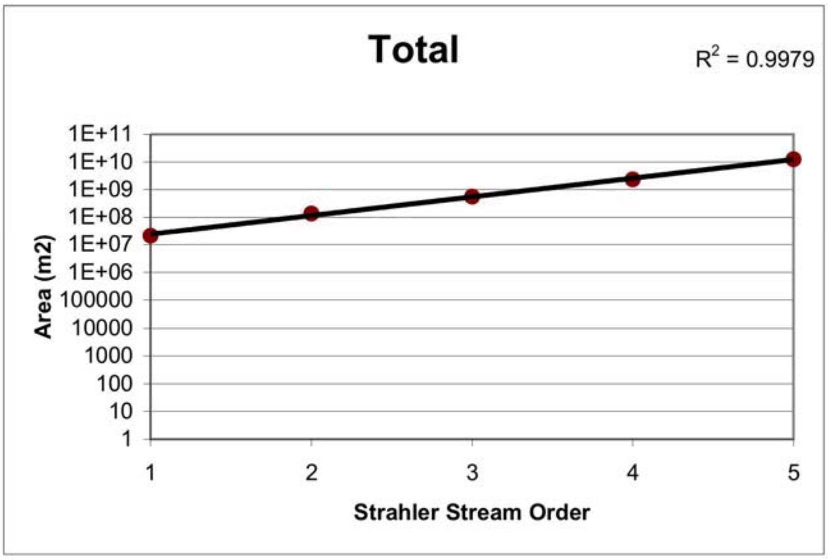
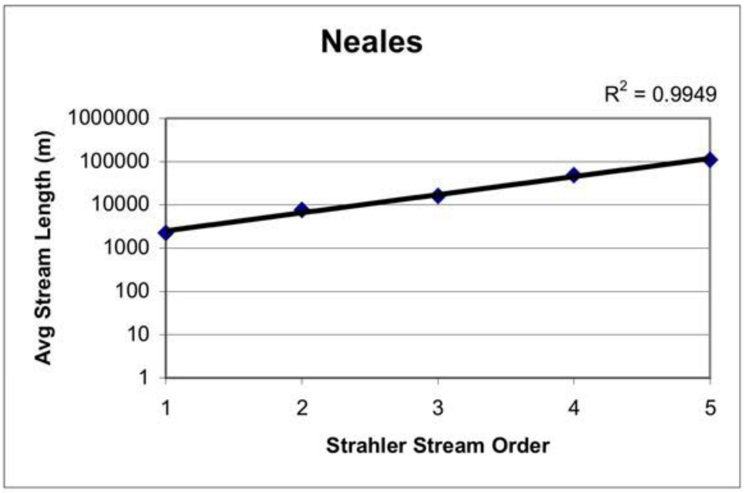
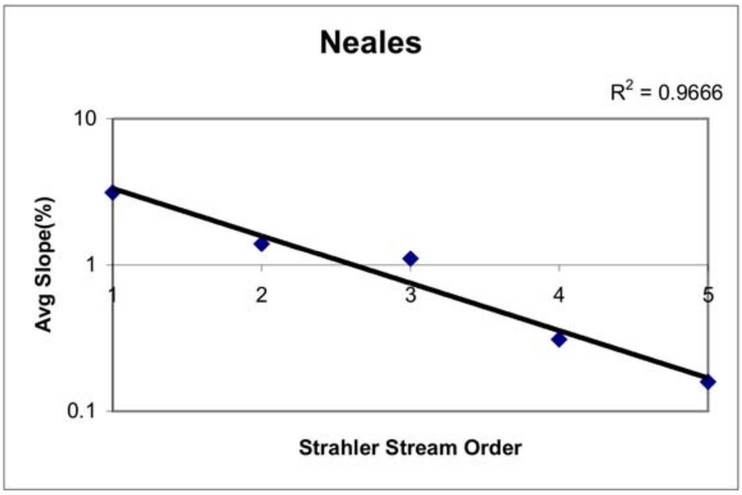


Figure 5.15: Morphometric analysis of all basins, displaying log-normal distribution.





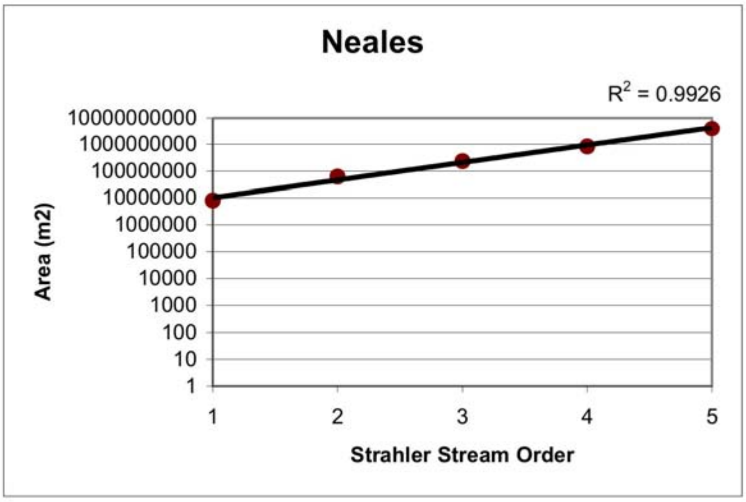


Figure 5.16: Morphometric analysis of the Neales River Sub-basin, displaying log-normal distribution.

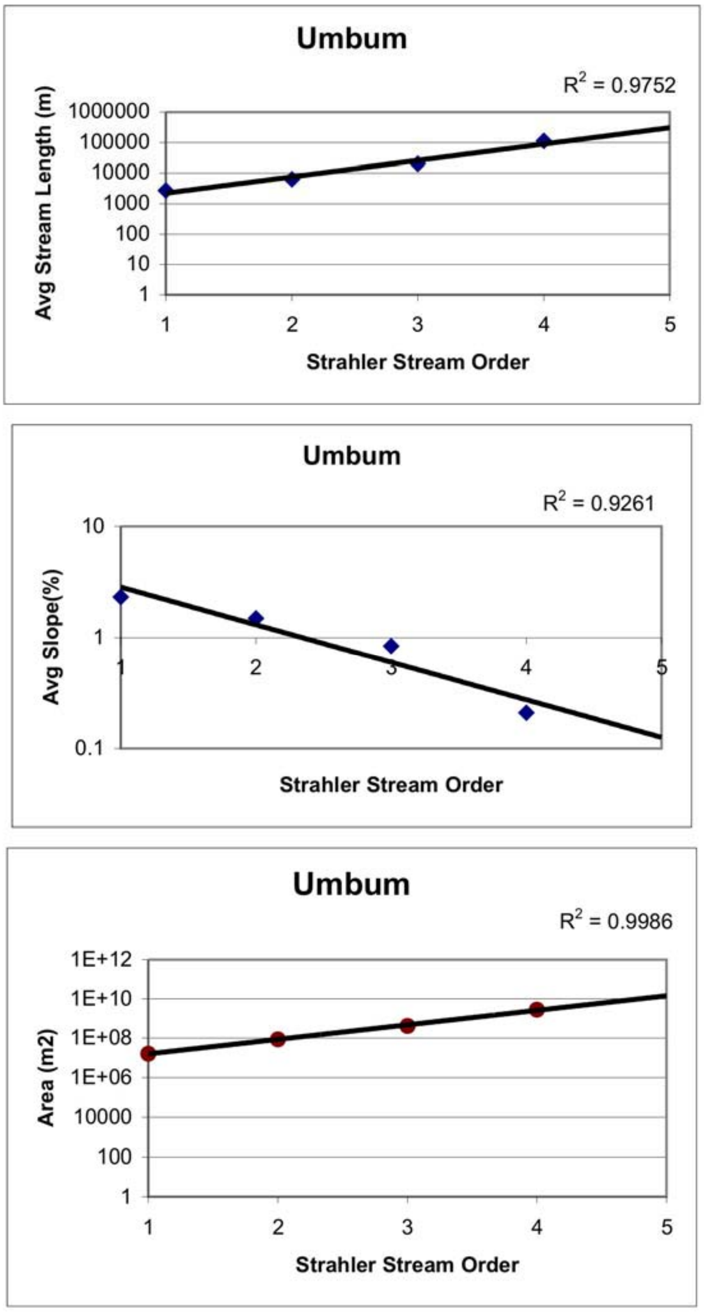


Figure 5.17: Morphometric analysis of the Umbum Creek Sub-basin, displaying log-normal distribution.

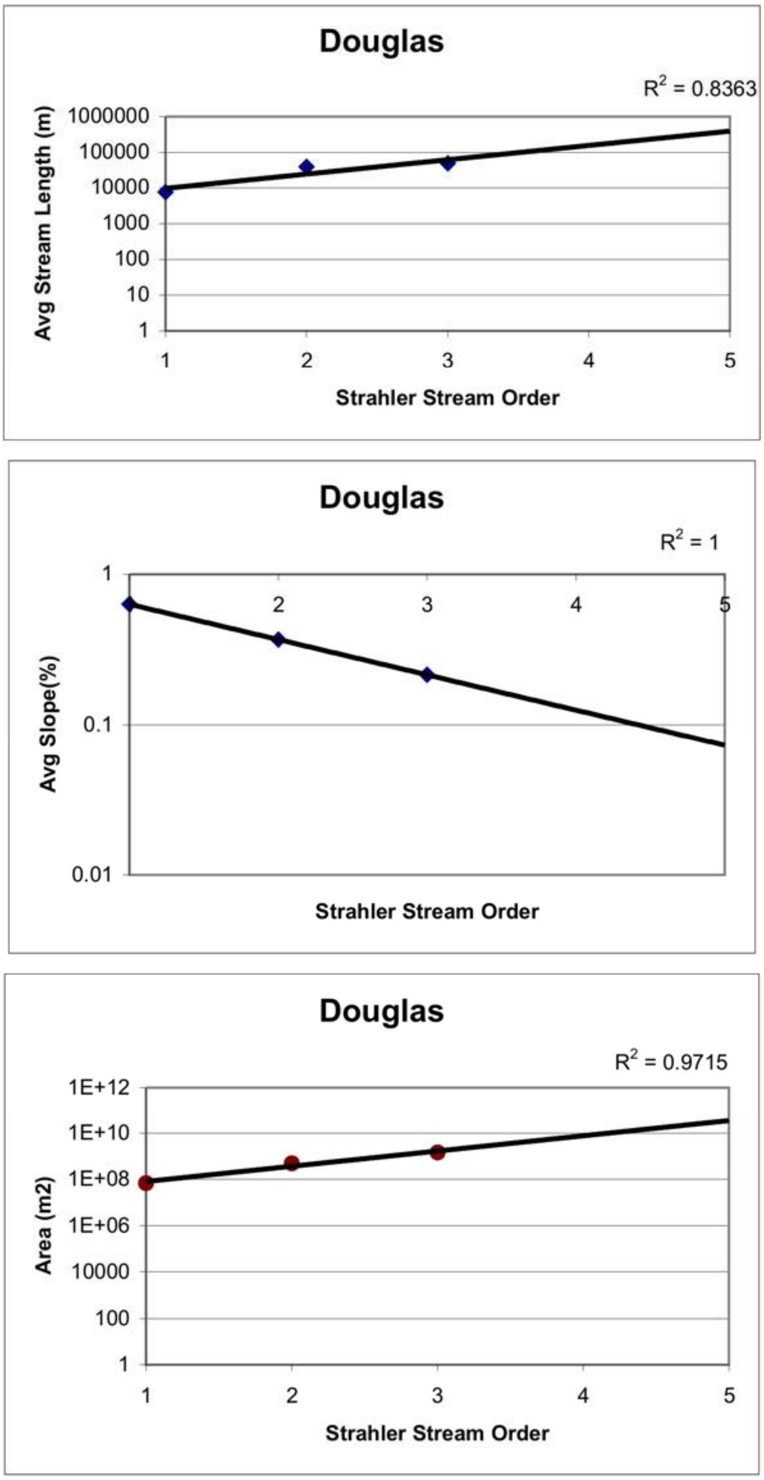


Figure 5.18: Morphometric analysis of the Douglas Creek Sub-basin, displaying log-normal distribution.

In the three sub-catchments analysed, there is a distinct grouping of the hypsometric curves into curve shapes associated with the sub-catchment's position in the landscape (Figure 5.19). The Neales and Umbum sub-catchments both have their headwaters in the Davenport Ranges, whereas the Douglas emerges from the southern flank of the Davenport Ranges. The Douglas appears to correlate with a less eroded stage. The Neales and Umbum sub-catchments display a strong convex-down curve and are considerably more eroded catchments (Thornbury, 1969).

The hypsometric integral (Table 5.1) sums up the basin properties into one number (Riquelme *et al.*, 2003). These are all low in this region with a value of 20 cited as a general lower limit (Thornbury, 1969). The hypsometric integrals are in accordance with a dissected, eroding landscape (Thornbury, 1969).

5.7 ELEVATION HISTOGRAM

If a landscape bears evidence for more than one cycle of uplift, it will yield a multi-modal histogram of elevation frequencies (Thornbury, 1969). In the study area there appear to be three clusters of peaks that may represent discreet tectonic events (Figure 5.20). These are situated at 2.5 m, 40–50 m and 100–150 m elevations. The lower elevation peak may represent the influence of lake shoreline processes on the geomorphology. However, while there are some peaks on the histogram that stand out, the overall shape of the histogram is uni-modal and it is likely that the region has been deformed by only one identifiable tectonic event. The histogram is highly skewed towards low elevations, indicating that this region is predominately of low relief.

5.8 GEOMORPHOMETRY

Relative Stream Power (RSP) (Figure 5.21) generally increases along the three main sub-catchments becoming greater downstream. Sediment Transport Capacity (LS) (Figure 5.22) is generally highest in the upper reaches of the catchments emanating from the Davenport Ranges. Exceptions to these trends occur downstream of the Lake Eyre Fault. There is an increase in Relative Stream Power and Sediment Transport Capacity in this area directly to the east of the fault where the Neales River and Umbum Creek cross it. On the Neales River the point immediately downstream of the fault represents the maximum values along the river for both RSP and LS. Similarly, Umbum Creek displays major increases in RSP and LS directly to the east of the Lake Eyre Fault.

5.9 RANGEFRONT SINUOSITY

An active rangefront is generally straight, whereas an inactive one becomes increasingly embayed. The sinuosity of a rangefront is therefore a useful indicator of long-term tectonic activity and a measure of maturity. Sediment fluxes can vary rapidly with climate, and changes in sediment and water discharge may lead to fan-head incision or aggradation that is independent of tectonic variation (Bull, 1984).

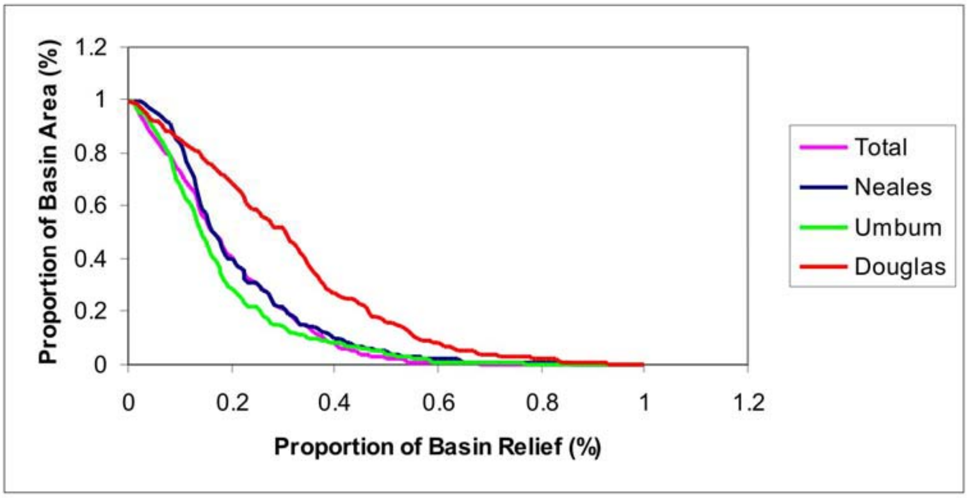


Figure 5.19: Hyspometric curves showing convex-down shapes associated with high erosion rates.

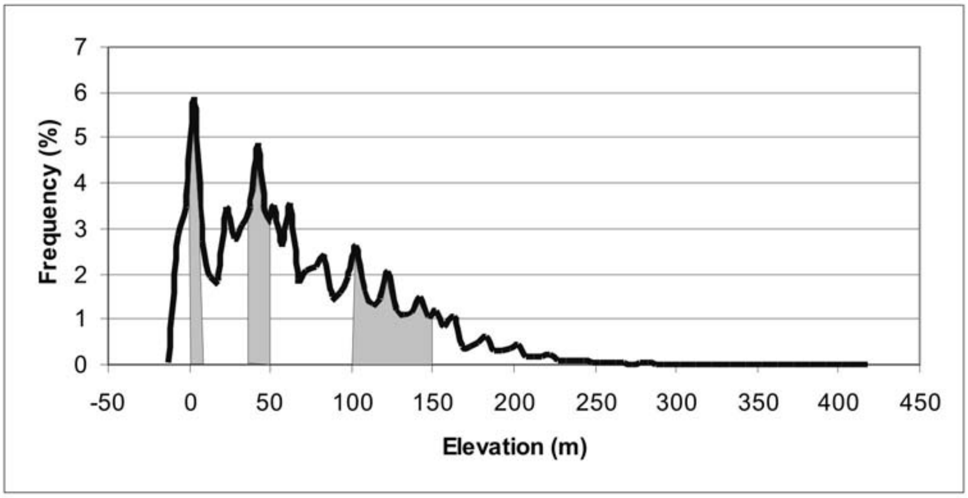


Figure 5.20: Elevation histogram showing clusters of peaks in elevation at 2.5 m, 40-50 m and 100-150 m that are possibly associated with palaeo-land surfaces and may indicate tectonic events.

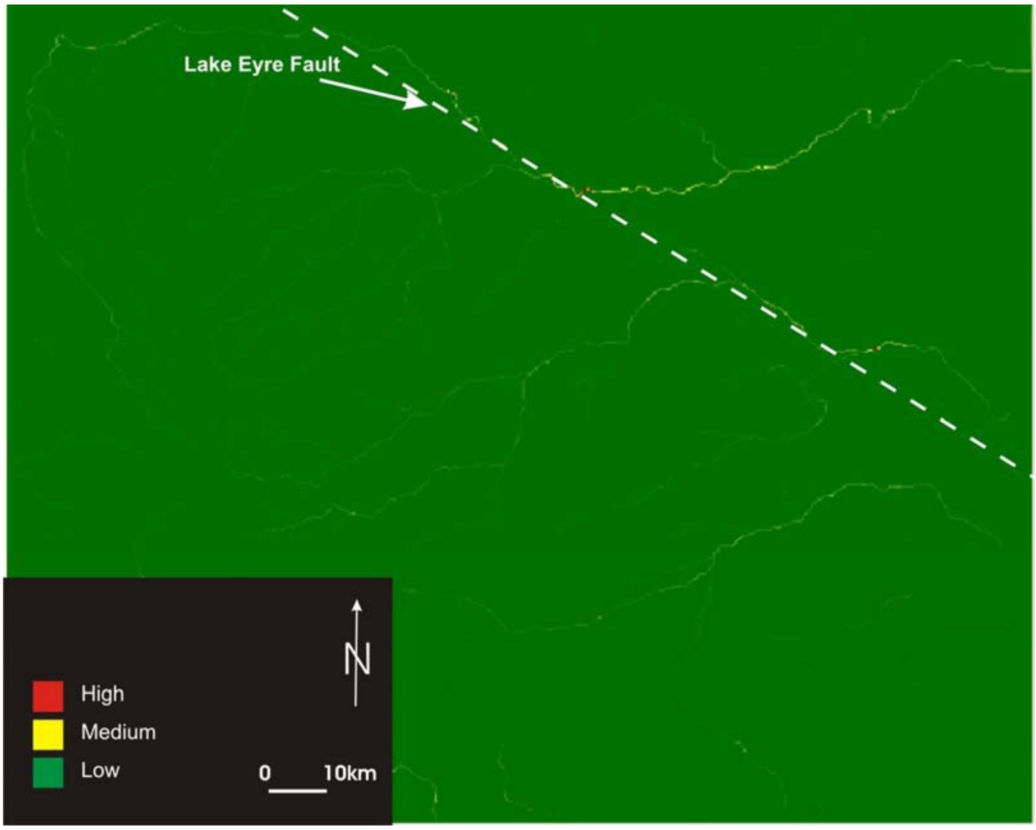


Figure 5.21: Relative Stream Power (RSP) showing a general increase in stream power downstream but with the highest values occurring east of the Lake Eyre Fault.

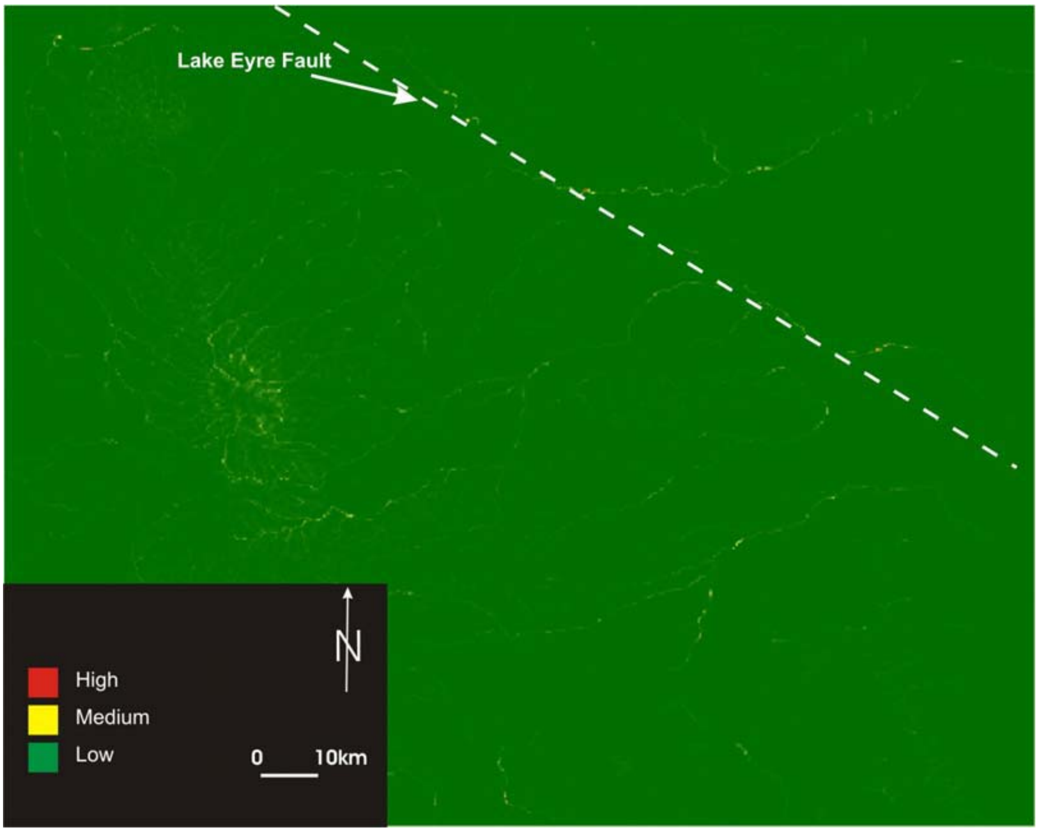


Figure 5.22: Sediment Transport Capacity (LS) demonstrating increases in LS east of the Lake Eyre Fault.

Rangefront sinuosity, S, is determined by dividing the length of the mountain-piedmont junction, L_{mp}, by the length of the associated range, L_r.

$$S = L_{mp} / L_r$$

The total length of the rangefront is generally of low sinuosity and may be interpreted as a quite recent landscape feature (Table 5.2). The section between Hope Creek and Levi Creek displays very low sinuosity. The northern section from Levi Creek to Salt Bore also has low sinuosity, indicating it too is of recent origin. The southern section has a much higher sinuosity, suggesting it is older.

Table 5.2: Calculated values of rangefront sinuosity indicating that the rangefront is a young landscape feature.

SECTION	**LOCATION**	**SINUOSITY**
Total	Blackfellow Quarry to Salt Bore	1.3
North	Levi Crk. to Salt Bore	1.269
Mid	Hope Crk. to Levi Crk.	1.008
South	Anna Crk. Bore to Hope Crk.	1.625

Several factors are associated with the higher sinuosity sections. These are areas of exposed Jurassic sediment which form low hills that are eroding, reworking fluvial sediments and forming embayments in the rangefront. The escarpment of the low sinuoisty medial section is preserved in Mt. Margaret Quartzite. This unit tends to form striking cliffs that are resistant to weathering, preserving the linearity of the rangefront. It is therefore probable that fluctuations in rangefront sinuosity are attributable to lithological variation and the fault movement has occurred at the same time across the face of the rangefront.

5.10 FLOODING SURFACE ANALYSIS

Utilising the 9 Second DEM, a series of arbitrary flooding surfaces were tested, ranging from –5 m to 50 m AHD in Microdem. This was conducted in order to identify any topographic expression of possible structural geologic features.

The results of the flooding surface analysis concur with the analysis of De Vogel *et al.* (2004). Using the same DEM product, De Vogel *et al*. (2004) performed a similar flooding of the palaeo-hydrologic lake levels, identified from recognised stranded beach ridges in the region surrounding Lake Eyre. They identify four lake stages (Table 5.3)

These flooding surfaces are projected onto the modern topography. For each of the flooding events time-equivalent sediments have been dated beneath the modern land surface on the Neales Fan (Croke *et al.*, 1996). The lake shoreline at these times was likely to be in a

Table 5.3: Identified palaeo-hydrologic lake stages after De Vogel *et al* (2004)

FLOOD EVENT (ka B.P.)	**FLOOD LEVEL(m AHD)**
40	-10
60	-3.5
80	+5
125	+10

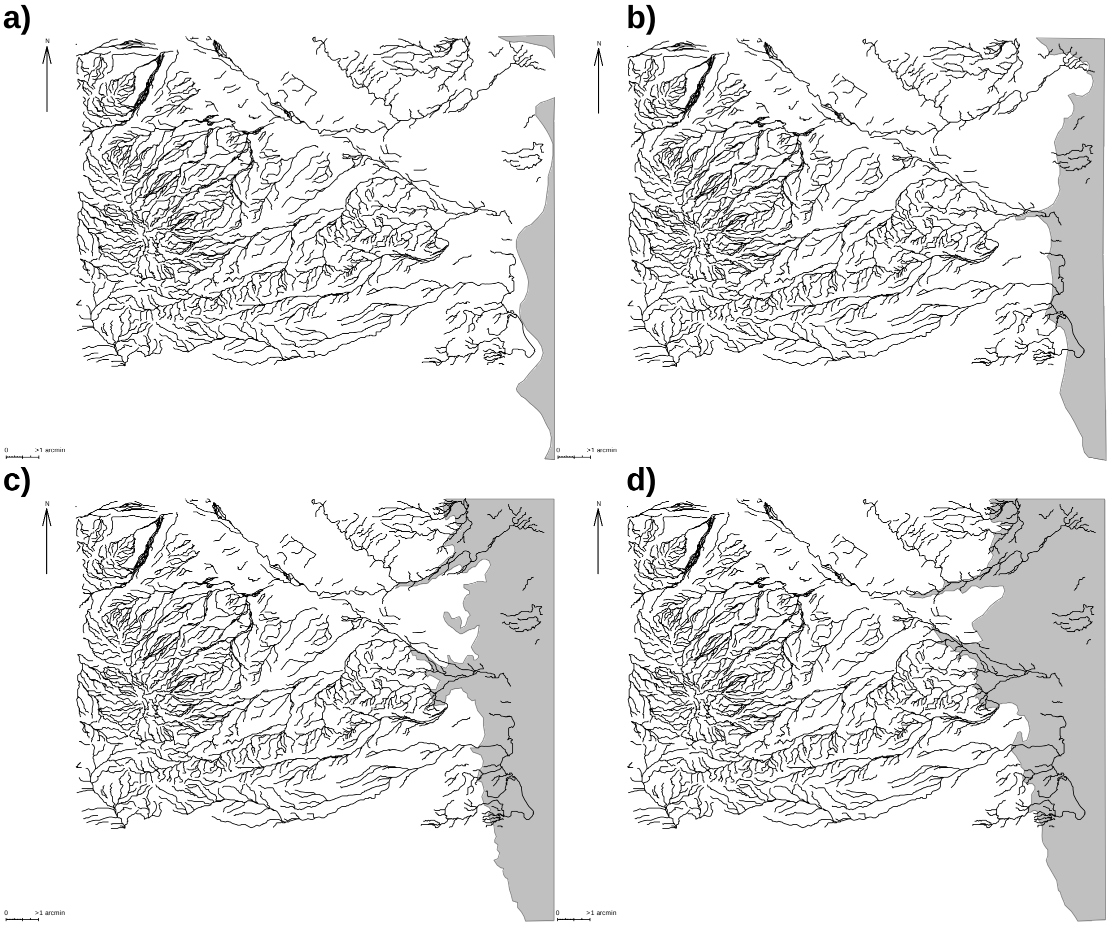


Figure 5.23 : Modeled results for flooding at a) –10 m AHD, b) -3.5 m AHD, c) +5 m AHD and d) +10 m AHD, showing the calculated flooding levels over modern topography.

different location, probably further inland than the modern shore. The palaeo-topography was different and suggests that significant aggradation occurred from the earliest floods onwards. Thus accommodation space was created due to a change in base level possibly as a result of tectonic activity.

5.11 DIFFERENTIAL GPS SURVEY

In addition to data obtained from DEMs, topographic data was collected via a Real Time Kinematic Differential Global Positioning System (RTK-DGPS) survey. This survey measured several survey lines across the Neales Fan, and a number of traverses were conducted across both the Umbum Creek and Neales River channel to determine the cross-channel profiles (Figure 5.24).

5.11.1 Neales River Cross-channel Profiles

The cross-channel profiles of the Neales River show a general asymmetry and incision (Figure 5.25). The Neales River at the apex of the Neales Fan (Section 21) is at approximately 15 m AHD elevation, equivalent to the Umbum Overflow (Figure 5.25). Just downstream (Section 20), the Neales River is approximately 9 m AHD elevation, whereas the Umbum Overflow is at about 12 m AHD. This trend continues with the lowest elevation on the Ghost Section at approximately –9 m AHD. An asymmetry is developed down the length of the Neales River, displaying steeper southern banks and lower gradient northern banks.

5.11.2 Umbum Creek Cross-channel Profiles

It is noted that the Umbum Overflow has a very steep reach in its headwaters (Figure 5.26) and then becomes a low gradient stream at an approximate elevation of +10 m AHD. The cross-channel profiles show that the thalweg of the stream becomes progressively deeper as the stream incises towards the lake to a depth of approximately –12 m AHD (Section 11Umbum Figure 5.26). The expression of the cross-profiles again shows asymmetry with a tendency towards steep southern banks and low gradient northern banks (Section 5Umbum, 6Umbum and 7Umbum Figure 5.26). These steep banks become less pronounced downstream as the banks widen and the system becomes less confined.

5.11.3 Neales Fan Axial Profiles

Surveyed sections taken down the length of the Neales Fan show that the Neales Fan is gently sloping but displays an irregular surface (Figure 5.27). Section Neales-Coolibah displays a steeper slope towards the apex of the Neales Fan. The gradient then decreases but is disrupted by a break-in-slope evident on Section Coolibah-Packsaddle and Section Piarooka-Wildhorse. This suggests that some form of topographic lineament is present across the medial section of the Neales Fan (Figure 5.27).

5.11.4 Neales Fan Cross Profiles

When observed in cross-profile the Neales Fan displays a very obvious asymmetry, the surface of the fan being topographically skewed to the south (Figure 5.28). This surface is also disrupted into several terraces separated by modern channels that have formed at the edges of these terraces. The Neales River and Umbum Creek can be seen to be at similar elevation (Figure 5.28) but the Neales River displays a more sharply incised bank than Umbum Creek. This southerly trend of both erosion and incision indicates that there is a tectonic influence on the landscape, with relative uplift of the northern margin of the Neales Fan causing sharp, incised southern banks in major stream channels and a general degradation along the southern margin of the Neales Fan via erosion. The terracing present on the cross-profiles of the Neales Fan may be attributed to underlying block faulting. This is the probable cause of exposed bedrock in the northwest sector of the Neales Fan.

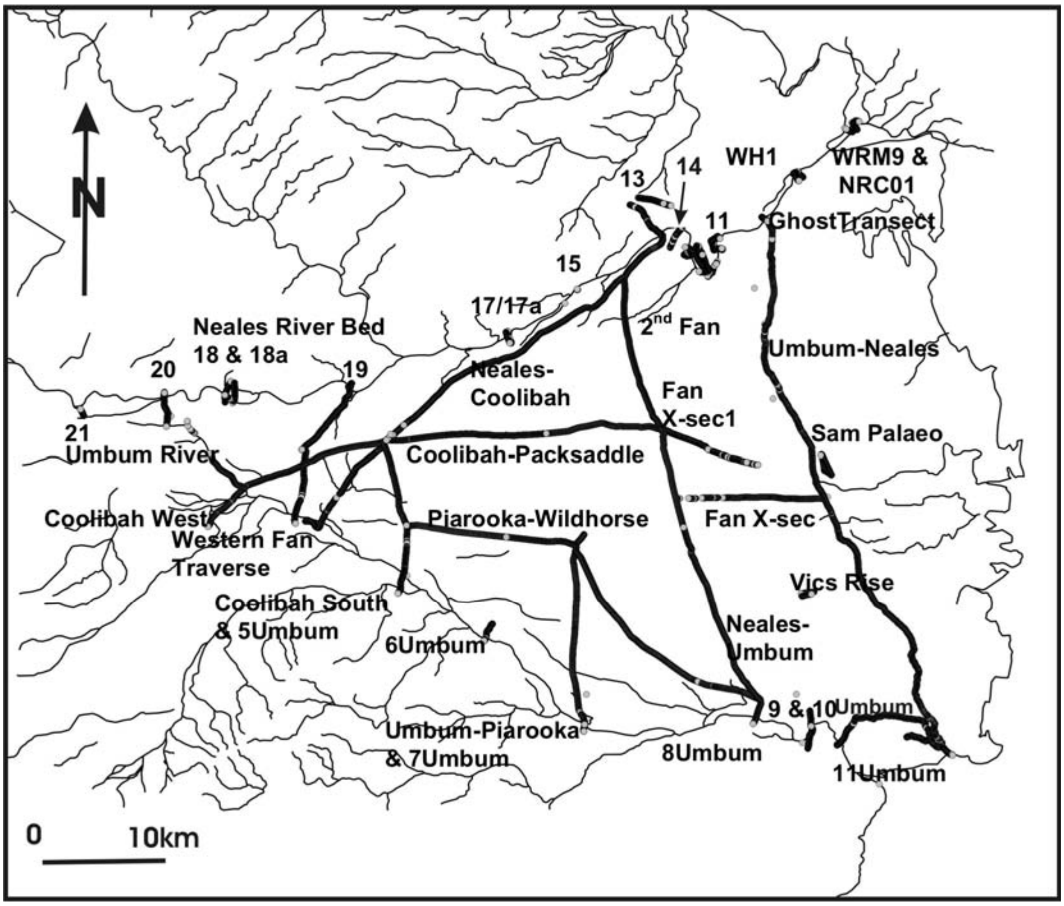


Figure 5.24: Location diagram showing the positions of RTK-DGPS survey transects.

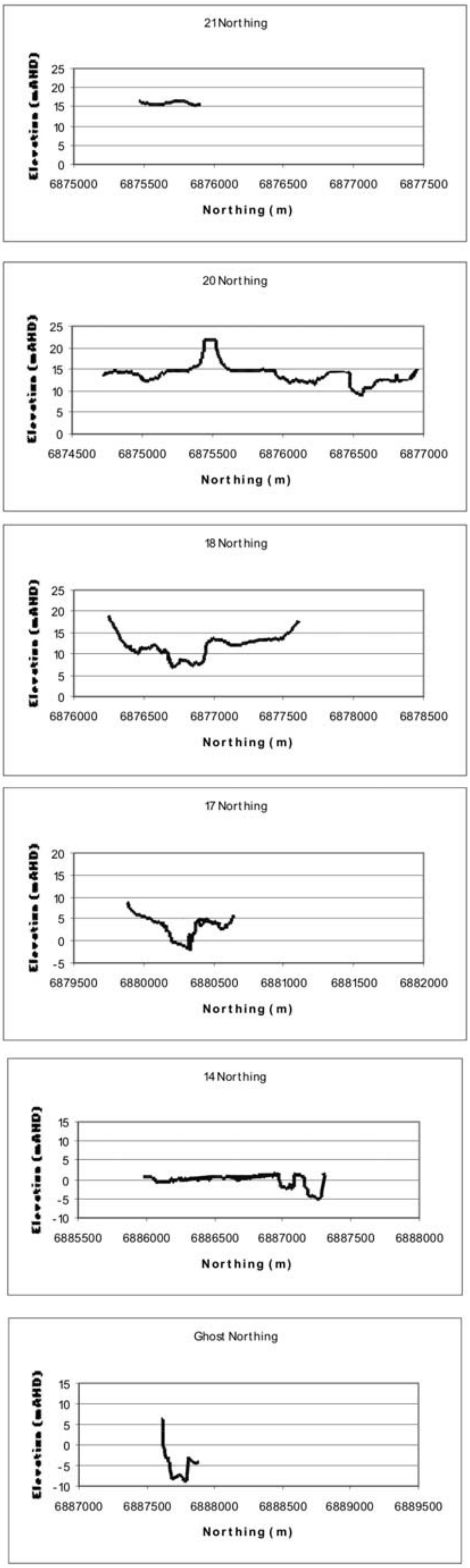


Figure 5.25: Selected RTK-DGPS surveys of the Neales River showing distinct valley asymmetry. See Figure 5.24 for profile locations.

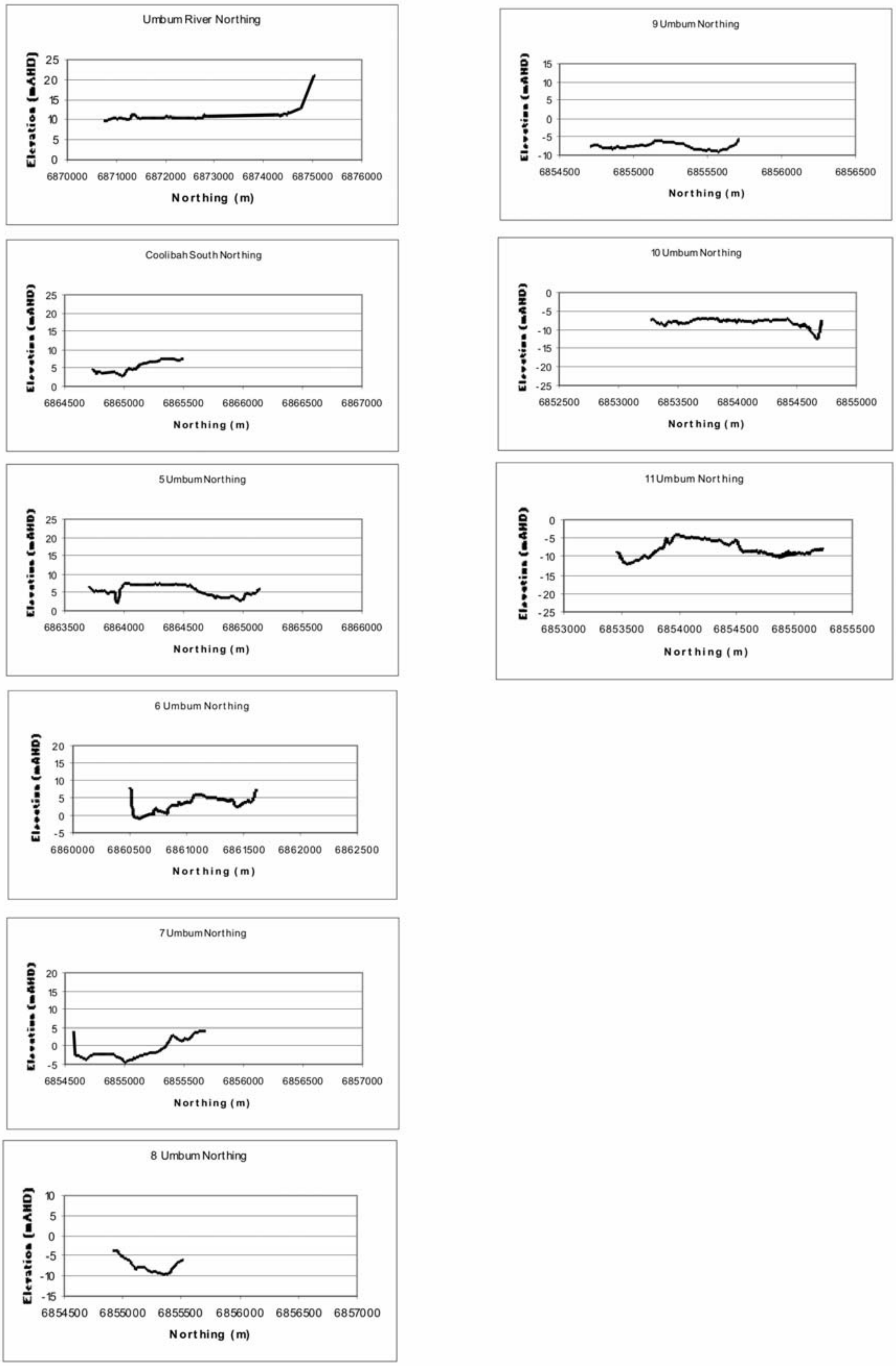
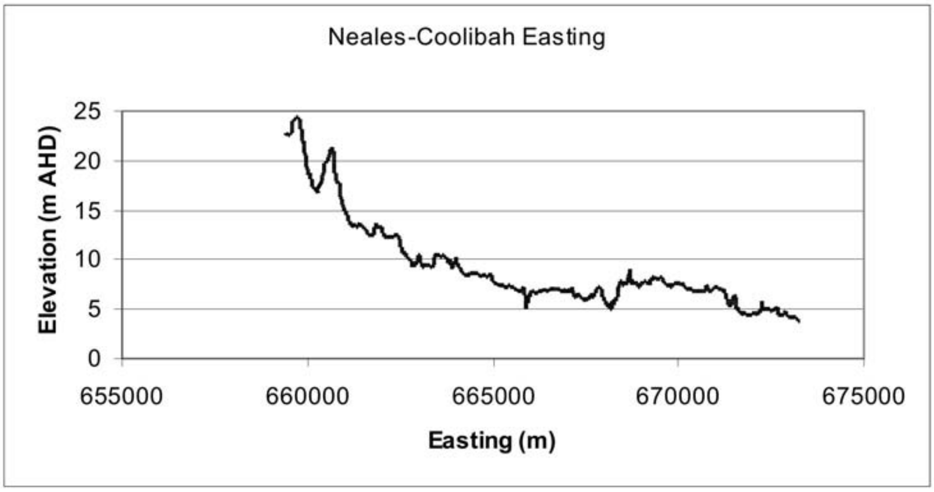
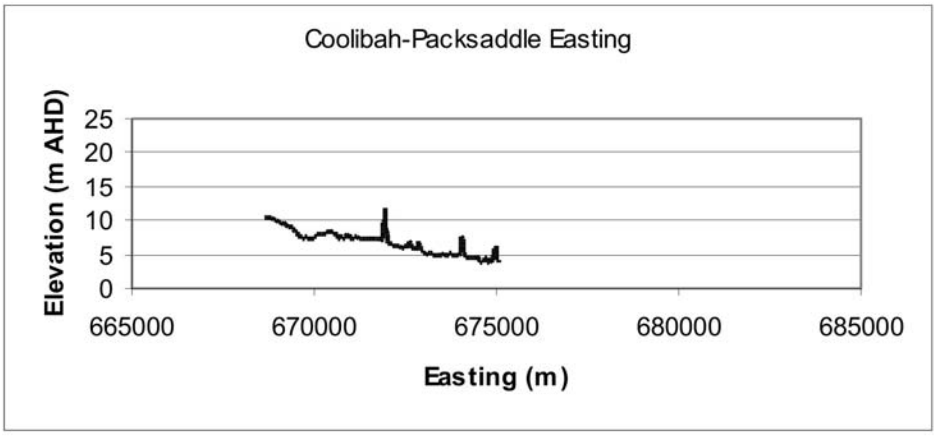


Figure 5.26: Selected RTK-DGPS cross-profiles of Umbum Creek showing asymmetry and flattening of relief downstream. See Figure 5.24 for profile locations.





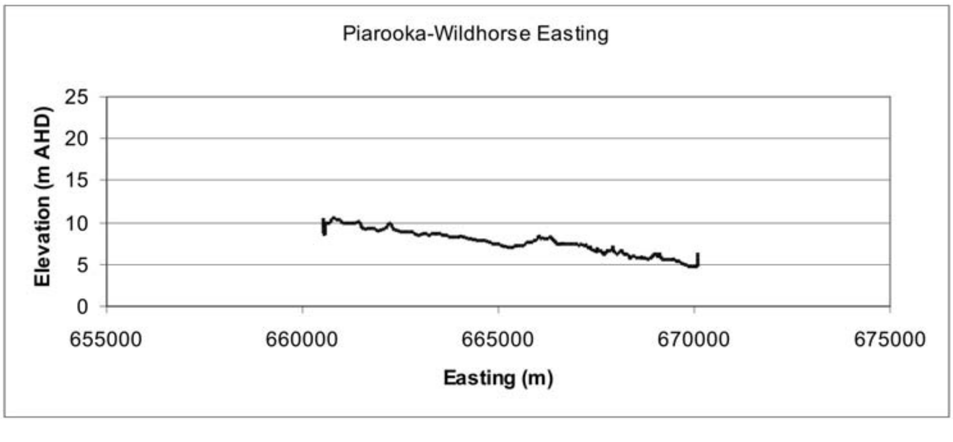


Figure 5.27: RTK-DGPS survey down the axis of the Neales Fan showing a gently sloping irregular surface with terracing. See Figure 5.24 for profile locations.

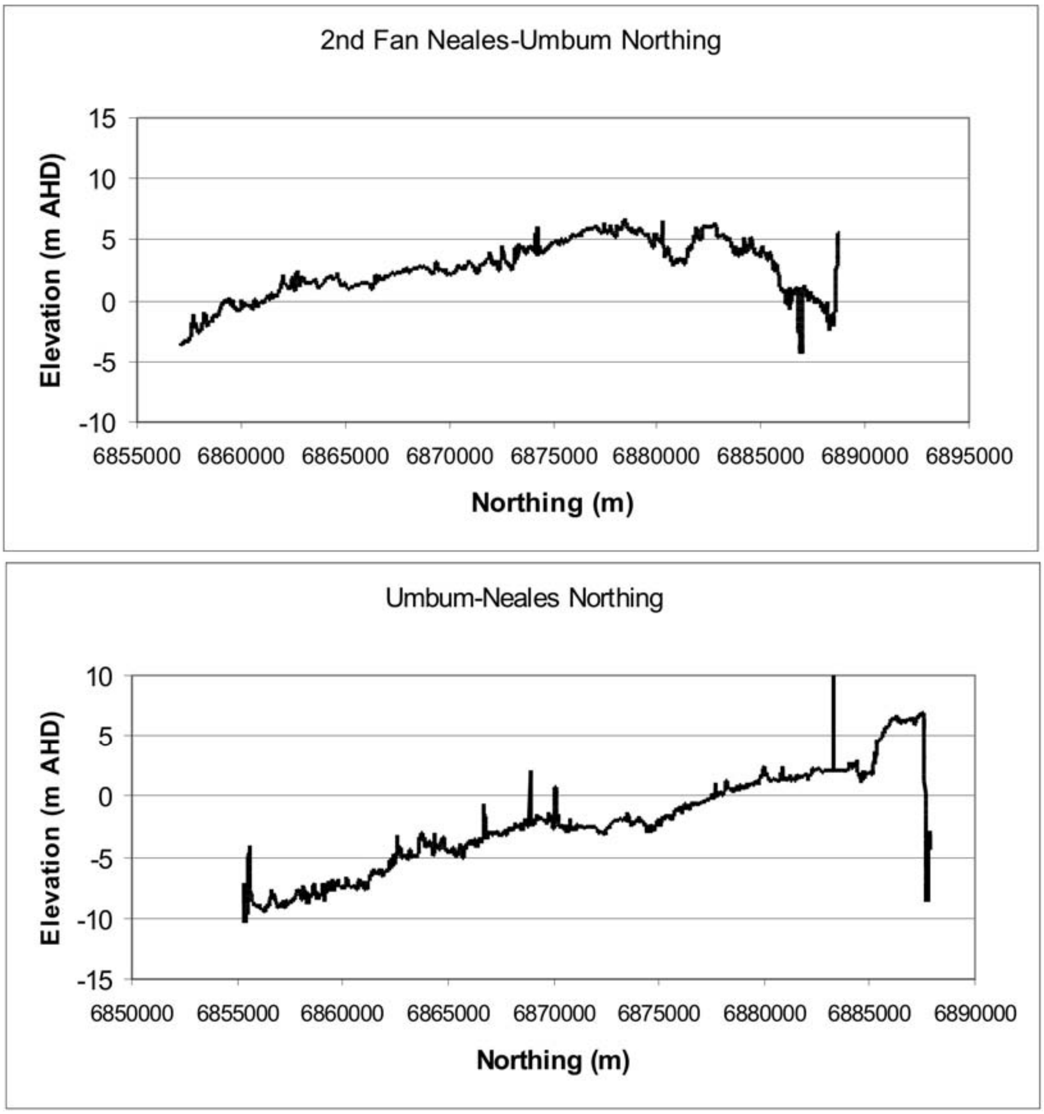


Figure 5.26: RTK-DGPS topographic survey across the width of the Neales Fan showing the asymmetry of the fan surface. See Figure 5.24 for profile locations.

5.12 GEOLOGICAL CROSS-SECTIONS

Subsurface geological data in Croke *et al*. (1998) does not provide sufficient accuracy to locate precisely the position of boreholes making it a limited dataset. Nevertheless, this limited dataset can be used in combination with DEMs and topographic profiles to construct geological cross-sections for the Neales Fan. It is assumed that where basement faults have been interpreted, that these are restricted to the Tertiary and do not displace Quaternary sediment.

What is evident from the borelogs is the presence of the Tertiary Eyre Formation beneath the fan surface. The distribution of this unit and of the Etadunna Formation is complex due to their fluvial-lacustrine nature. While the data points have been used as a constraint, the subsurface distribution is highly interpretive, attempting to account for faulting, draping and interdigitating of fluvial and lacustrine sediment.

5.12.1 Idealised Geological Section Neales Fan Looking North

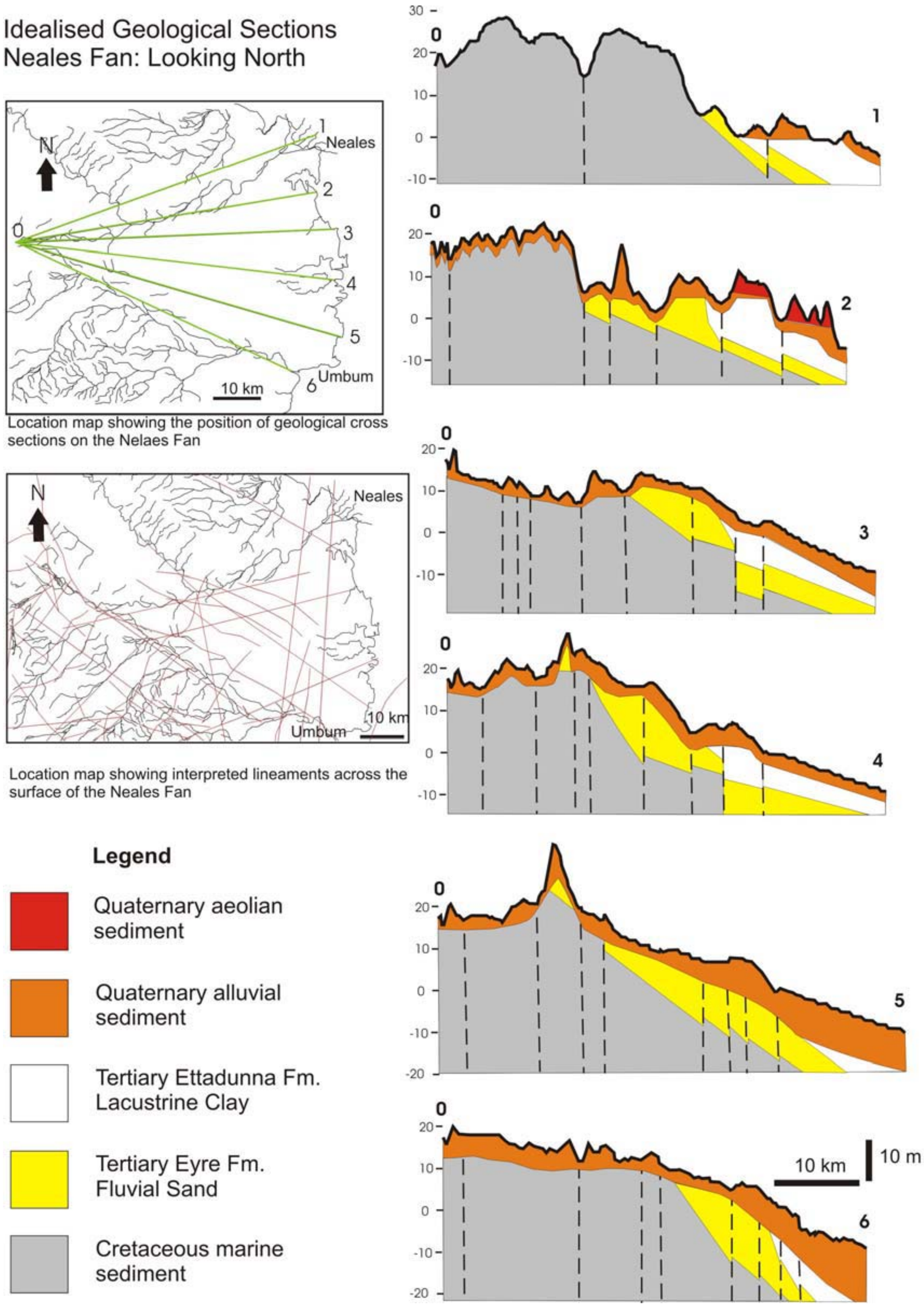
Axial profiles of the Neales Fan (Figure 5.29) demonstrate that the fan is not smoothly dipping from the apex to its distal segments, but is composed of a series of terraces. This is most evident in section 0–4 where a clear distinction is made between an upland terrace associated with Dividing Bluff and a lower terrace that is separated from the distal terrace by another break-in-slope. These terraces and other gullies that form on the surface of the fan are strongly associated with interpreted underlying basement faults. The geology is assumed to consist of tectonically disrupted, gently dipping, fluvial sands and lacustrine muds of Tertiary age.

5.12.2 Idealised Geological Section Neales Fan: Looking West

The geomorphology of the Neales Fan varies down its length (Figure 5.30). At the fan apex, the fan possesses a subdued topography (AA’). Further down the fan, Dividing Bluff emerges, forming the highest point on the fan. This is a region of subcropping exposure of Cretaceous Winton Formation. Boreholes drilled in this area indicate that a palaeochannel of Tertiary Eyre Formation lies beneath the subsurface. This is interpreted to be distributed in a fan-like shape with a long axial trend and lensoid cross-section (BB’-DD’). The morphology of the fan surface through this region is quite undulating in cross-section. This is due to the drainage network across the surface of the fan that is incising and forming alluvial erosional depressions. The more distal segment of the fan possesses a very flat morphology.

5.13 GEOMORPHOLOGICAL SUMMARY

Within the study area, drainage is generally controlled by underlying structure. Drainage diversions indicate faults that have been reactivated and captured existing streams. Where an area is surrounded by faults, such as the Four Hills region, divergent drainage style is an indication that this area has been uplifted and drainage is now eroding down into the bedrock. The asymmetric drainage style on Davenport Creek is associated with an elevated ridge and probable fault that has caused tilting. The Levi and Mt. Margaret Faults displays low sinuosity, inferring recent movement, which is reflected in the stream longitudinal profiles. Stream longitudinal profiles that cross the Levi and Mt. Margaret Faults display positive deflection, implying movement on this fault. The catchment is highly eroded and both Stream Power and Sediment Transport Capacity are at their maxima where streams cross the Lake Eyre Fault, implying movement on this fault after the streams were located in their current positions. The southerly trend on the topography of the Neales Fan and the style of stream incision infer relative uplift of the northern edge of the Neales Fan.

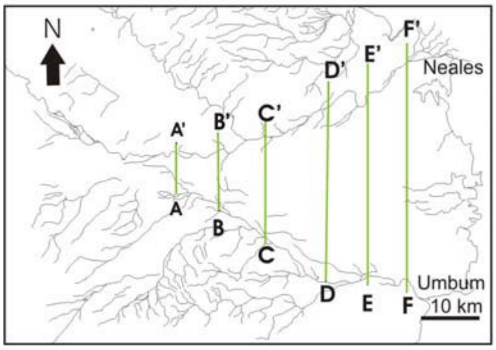


Location map showing the position of geological cross sections on the Nelaes Fan

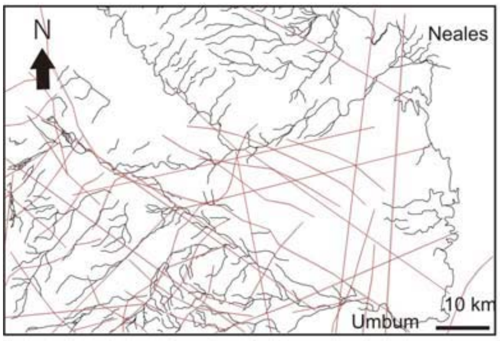
Location map showing interpreted lineaments across the surface of the Neales Fan

Figure 5.27: Schematic geological sections of the Neales Fan looking north, showing terracing in the Neales Fan surface possibly associated with tectonic adjustment.

Idealised Geological Sections
Neales Fan: Looking West



Location map showing the position of geological cross sections on the Neales Fan



Location map showing interpreted lineaments across the surface of the Neales Fan

Legend

- 🟥 Quaternary aeolian sediment
- 🟧 Quaternary alluvial sediment
- ⬜ Tertiary Ettadunna Fm. Lacustrine Clay
- 🟨 Tertiary Eyre Fm. Fluvial Sand
- ▨ Cretaceous marine sediment

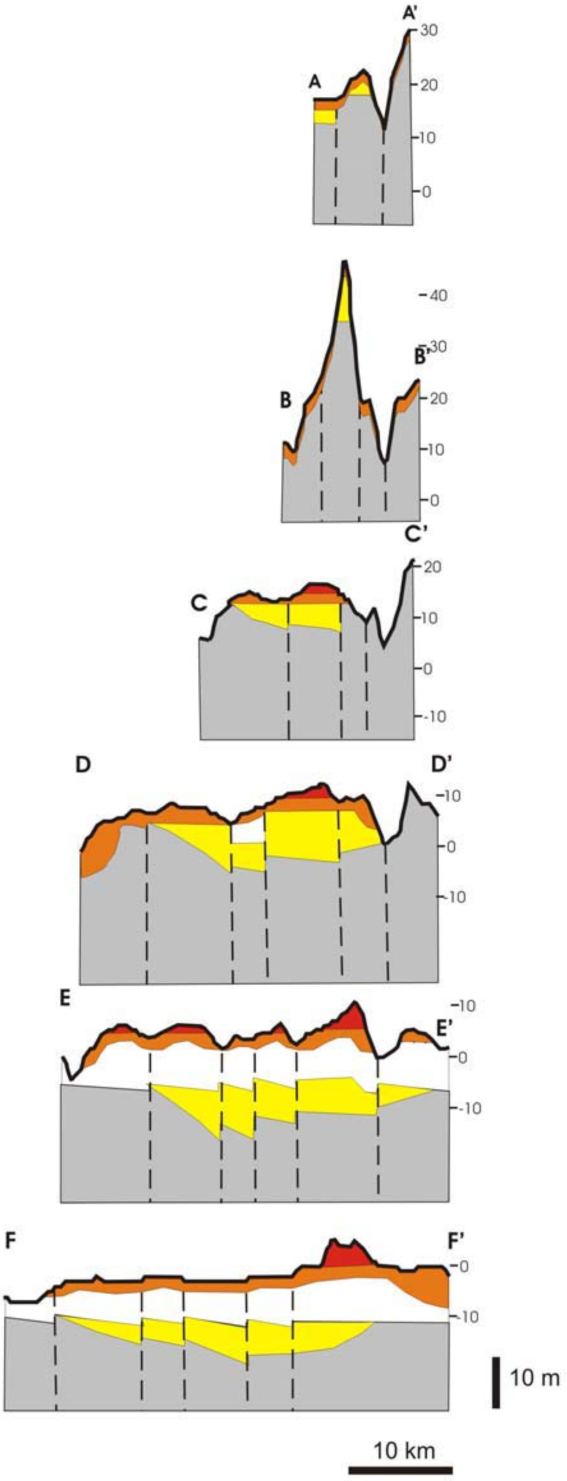


Figure 5.28: Schematic geological section of the Neales Fan looking west, showing the strong north to south asymmetry and dissection developed across the Neales Fan surface.