

ECOLOGICAL AND PHYSICAL CONDITION OF THE LOGAN RIVER AND TRIBUTARIES

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Introduction

This report provides an assessment of the “Condition” of the major streams of the Logan River catchment. These ratings have been determined through the use of the *State of the Rivers Methodology* developed for the Department of Natural Resources by Dr. John Anderson (1993). The data collected for this assessment was obtained in a one week intensive collection program in July 1996. This report is prepared for use as background information for a workshop assessing the Building Block Method of instream flow allocation.

Methodology

The “State of the Rivers” methodology (Anderson, 1993) provides a comprehensive method for classifying the current physical and ecological condition of rivers and streams. The basis of the classification is to divide the catchment under investigation into “homogeneous stream sections” which represent stream sections that share similar natural features and conditions. The delineation of these “homogeneous stream sections” involves a progressive division of the catchment into smaller and smaller units.

Initially, the catchment is divided into major subcatchments, each of which will have different or unique characteristics which influence the stream morphology within those areas. Using a variety of information, boundaries for stream division are established. This process is continued until the boundaries form the “homogeneous stream sections” required to give as accurate a description of the stream systems as is possible within a reasonable time frame. A “homogeneous stream section” is referred to as a “subsection” of the stream.

Attributes such as soil type and geology, vegetative cover, bank slope, stream gradients and sediment types are used to aid in the subdivision process. Boundaries for subsections may be located at natural barriers (such as waterfalls and wetlands), artificial barriers (such as dams and weirs), or at positions where major changes to attributes are likely to affect the natural features of the streams or their condition. In order to confirm the initial subdivision of streams and to select appropriate sample sites, an extensive reconnaissance survey is undertaken prior to the main survey.

Generally, sites are selected so as to be both representative of the stream sections they are intended to describe, and to allow relatively easy access, thus minimising the amount of time and resources needed to carry out each site survey. Sites are commonly situated upstream of road crossings or within reasonable walking distance of access tracks. Every effort is made to ensure survey sites are remote from disturbances associated with these access points, except of course where those access points have become a representative feature of the stream’s condition (for example, sites situated at weirs).

Data Collection and Analysis

For this survey the method has been modified to accommodate the short time frame required for completion of the survey and the resources available. Instead of the usual practice of catchment subdivision then selection of sites to represent these subsections, sites used by other researchers in this project have been used and stream subsections assigned to these survey sites. This resulted in 51 survey sites, including the 4 Instream Flow Requirement sites, and 37 subsections.

To produce the condition ratings for these subsections they were grouped into 14 subcatchments based on natural drainage catchments. For reporting purposes these catchment was divided into 5 subcatchments which related to the IFR sites, Map 1. These subcatchments are:

- Upper Logan, which comprises all streams which discharge through IFR Site 1 at Rathdowney,
- Mid Logan, which comprises the streams which discharge through IFR Site 2 at Bromilton Rock Bar but downstream of IFR Site 1,
- Lower Logan, which comprises streams discharging through IFR Site 3, at Paynes Bridge, but downstream of IFR Site 2,
- Teviot Brook, which is the catchment of Teviot Brook and discharges through IFR Site 4, and
- Tidal Logan which is the Logan River downstream of IFR Site 3.

This report presents the outcomes of the analysis for the four subsections which contain the IFR Sites and for the five subcatchments.

The data are stored in a set of linked databases using the *DBASE IV*. These databases form an integral part of the methodology, as they allow access to the raw and processed data.. The package includes a set of analyses and data manipulation programs. The condition ratings for each attribute are produced from a set of formulae which employ various weighted combinations of the raw data. Each of these ratings is scored as a percentage, with 100% representing very good condition and 0% very poor. The general condition categories for most attributes, are outlined in Table 1.

Table 1 Condition Rating Categories

Condition Category	Rating (%)
Very Poor	0 -20
Poor	21 -40
Moderate	41 -60
Good	61 -80
Very Good	81 -100

In addition to the written information obtained, a set of at least five photographs is taken at each site, providing an additional record for future reference. The basic set includes photographs of upstream and downstream sections of the stream channel, left and right banks (looking downstream), and a wideangle view of the reach environs.

Analysis of individual characteristics examined during the survey is undertaken, as well as an overall assessment based on all components. Not all data collected were utilised in the present study and may be the subject of additional reports. The data are available on request. Data summaries are presented bar graphs, and in tables where appropriate.

The presentation of the analysed survey results occurs in several formats depending on the attribute being described. A summary of terms used is provided below:

- **% of stream lengths**
refers to the length of streams described as having a particular characteristic divided by the total length of surveyed streams within that subcatchment, and expressed as a percentage.
- **% of sites**
refers to the number of sites with a particular characteristic divided by the total number of sites within that subcatchment, and expressed as a percentage.
- **% of bank lengths**
refers to the number of banks (two banks recorded at each site) with a particular quality divided by the total number of banks in that subcatchment (that is, number of sites by two), and expressed as a percentage.
- **% of reach lengths**
refers to the number of reaches with a particular quality divided by the total number of reaches in that subcatchment, and expressed as a percentage.
- **% of bars**
refers to the number of bars of a particular type divided by the total number of bars within that subcatchment (of all types), and expressed as a percentage.

Lastly, in some cases the listed percentages for a particular characteristic or quality may not equal 100%. This discrepancy can be attributed to rounding error, where obtaining percentage results does not give a realistic figure. An example of where this need arises is when percentages of site figures give fractional values. In these situations, figures are rounded in order to describe those attributes as applying to whole sites.

Survey Method

The survey method employs a “snapshot” approach, such that various key components of the stream, banks, and environs are recorded. Assessments are made along reaches of varying length at each site. The reach is selected to include representative examples of the major habitat types found in the particular “homogeneous stream section”.

Each survey takes approximately 45 to 60 minutes to complete and involves a team of at least two people. Thus, depending upon travelling time between sites, approximately eight to ten sites can be surveyed per day. A large number of sites are surveyed in an attempt to adequately portray the variability in stream type present within the catchment.

The majority of sites surveyed are full survey sites, where a complete set of the required data is collected. However, in areas where special or unique features are present and can not be adequately recorded using the standard methodology or where the features are not considered fully representative of the stream length being described, ‘photo only’ sites may be recorded. Further, where appropriate, sites can be situated at the location of previous studies (stream gauging stations) to allow possible correlations to be drawn in future studies.

At each full survey site, a set of comprehensive data is collected with the aid of 11 data sheets designed to record key components of the stream and its environs (refer Appendix 1). A separate data sheet and database is provided for each component, descriptions of which are detailed below.

Reach Environs

Reach environs are those lands immediately adjacent to the riparian zone for the reach and include the floodplain and valley flat. The condition rating for this attribute is produced by assessing the extent of clearing or disturbance of the riparian vegetation and the vegetation on the adjacent lands, including the extent of invasion by weed species. The land tenure, land use, vegetation type and forms of disturbance are all used to produce the derived rating.

The highest rating of 100% is given only to sites which have undisturbed vegetation and no local disturbances likely to impact directly on the stream (often sites in National Parks, State Forests, or areas operating under some form of protective management). Sites in areas where the floodplain and valley flat areas have been cleared for grazing or extensive agriculture are generally rated poorly.

Subjective assessments of disturbance levels present in the reach environs are also recorded at the time of survey and provide an overall impression of the condition of the reach environs (*Appendix 1, Sheet 4*).

Very high disturbance ratings are produced when the land on both sides of the stream has been cleared or has a significant weed presence. Highly disturbed sites would have valley flat vegetation completely cleared on one side of the stream, with native vegetation on the other side clearly disturbed or with a high percentage of introduced species present. A moderately disturbed site would also have the valley flat vegetation completely cleared on one side of the stream, but with native vegetation on the other side in a reasonably undisturbed state. Sites with low disturbance ratings would have native vegetation present on both sides of the stream with riparian vegetation consisting mostly of native species and with a reasonably intact canopy.

Channel Habitat Diversity

The proportion and dimensions of the channel habitats occurring within the reach are recorded. The types of habitats recorded include waterfalls, cascades, rapids, riffles, glides, runs, pools and backwaters (Appendix 1 Sheet 5). An index of the diversity of habitat types is calculated, based on the number of different habitat types present. The basic premise behind this rating is that the greater the range of habitat types present in stream sections, the greater the diversity of both flora and fauna species likely to be supported by the stream system (Koehn and O’Connor, 1990).

Channel Form and Dimensions

The channel dimensions and channel habitat types (pools, runs, riffles, cascades, rapids *et cetera*) are important attributes of streams both physically and ecologically. Cross-section measurements are made of the major channel habitat types. Measurements taken within the channel include channel width and depth, and bank slope, width and height. A diversity of widths and depths is likely to be indicative of a range of habitats and microhabitats and in turn may be used as an ecological indicator of the possible range of fauna and flora species present (Koehn and O'Connor, 1990).

Bed and Bank Sediments

At the time of taking channel cross-sections, the sediment composition of the bed and of the lower and upper banks is also recorded (*Appendix 1, Sheet 6*). The mean size of the sediment is determined for each of the major channel types from these data during the computer aided analysis. Sediment size is an important determinant of stream invertebrate distribution and abundance, which in turn influence the presence and diversity of fish species (Koehn and O'Connor, 1990).

Further, comparison of bed and bank sediments can indicate sources of instream sediment and the relative importance of bank erosion within the catchment.

Bank Stability

The bank condition ratings are determined from the recorded percentages of the banks on each side of the reach which are rated as stable. The derived rating is produced by assigning 80% of the score to the upper bank and 20% to the lower bank. The values are then averaged for all banks assessed in each subsection. The dominant processes at each site (erosion, slumping or aggradation) are also recorded. The final condition ratings represent the average percentage of banks at the site determined to be unstable. A score of 100% is achieved where all banks at the site are completely stable. Low scores occur when a high proportion of the banks is unstable due to the effects of erosion, slumping, or aggradation processes (*Appendix 1, Sheet 7*).

Bed and Bar Stability

Bed and bar condition ratings are determined from the recorded proportion of stream beds forming bars (for aggrading beds) and the overall bed stability rating (for eroding beds). The dominant process and stability of the stream bed are assessed, and the location, size, and particular features of bars also documented. Sites with no bars present or with stable beds are rated at 100% (stable). Sites with large bars (indicating highly aggrading beds) or with severely eroding beds are given unstable ratings.

Additionally, a subjective rating of the overall bed stability is recorded by assessing general criteria relating to the size and consolidation of bed sediments, proportion of bed covered by bars, and shape and dimensions of the channel. These ratings range from very poor to very high value (*Appendix 1 Sheet 8*, provides a description of the assessment criteria).

Further, the ease of passage through the reach for aquatic organisms is assessed by classifying the instream barriers present (natural and artificial) and estimating the required flow level to overtop these barriers.

Riparian and Aquatic Vegetation

The survey technique is designed to assess the riparian vegetation zone and the instream aquatic vegetation in terms of

- the percentage cover by structural vegetation types (trees, shrubs, herbs, emergent aquatics, floating aquatics), and
- the percentage cover over the riparian zone or the stream bed.

The overall condition rating for riparian vegetation is composed of both a width factor and vegetation factor. The condition rating is calculated by multiplying the width factor and vegetation factor together.

For the purpose of obtaining the vegetation factor component of the riparian condition rating, riparian vegetation is grouped into various structural categories (tall trees > 30 m; *Appendix 1 Sheet 9*). These

structural levels are weighted differently depending on the value of the structural category to the stream system. For example, a riparian zone with a diverse mixture of tall trees and understorey plants is rated more highly than a zone consisting only of trees or only of shrubs and grasses. Additionally, the contribution of each structural type is reduced by 30% times the percentage of weed species in each type. The vegetation factor is further reduced for areas of bare ground in the riparian zone.

The width factor is a function of two recorded figures, the Riparian Zone Width and the Existing Vegetation Width, and of a Vegetation Scaling Factor (refer *Appendix 1, Datasheet 9*). The function firstly multiplies the existing vegetation width by the scaling factor which consists of a score of between one and three, as detailed below:

- highly disturbed or with a distinct boundary on the vegetation edge (within 50 m; scored as 1);
- disturbed, thinly cleared, or semi-natural vegetation (scored as 2); or,
- undisturbed, natural vegetation (scored as 3).

This total is then added to the recorded riparian width to produce the riparian width factor. The last step in obtaining the riparian condition rating is to multiply the vegetation and width factors together and to rescale the values to give ratings between 1% and 100%.

Although this method may appear overly complex, it allows riparian zones of different natural widths to be compared in terms of their contribution to the stream system and in terms of their representativeness of their natural or undisturbed condition.

The aquatic vegetation is grouped into submerged rooted plants, floating vegetation and emergent vegetation, each of which is subdivided into broad common types.

Aquatic Habitat

Aquatic habitat condition ratings are based upon a combination of the percentage cover of the stream bed by instream debris, rock outcrops, and vegetation, and the overhanging stream cover provided along the bank by vegetation, bank, and man-made overhang. The formula used to determine this rating gives higher values to sites with a high diversity of cover types and with a large amount of cover of wetted area.

The overhanging stream cover contribution is derived by using a combination of the width of cover and a weighting for each recorded type (canopy, vegetation overhang, root overhang and bank overhang). Sites which have a diverse range and high percentage cover in the stream and along the banks are assigned the highest rating (100%). Individual cover types are also weighted according to their relative importance. For example, dense log jams are weighted at 100%, single logs at 90%, single branches at 80%, roots along the banks at 90%, access to boulders and rock crevices at 75% and *Macrophyte* debris at 50%. In deriving the final rating, 60% contribution is given for the instream cover and 40% for the overhanging stream cover.

In the event that water levels in surveyed streams are low or absent, the estimates of cover type area are made for the water mark stream depth.

Further, a subjective assessment of the overall aquatic value is recorded and is intended to combine all the assessment items and general signs at the site to assign overall ratings for fish, invertebrates, birds, and mammals. These ratings range from very poor to very high value (see *Appendix 1, Sheet 10*, for a description of the assessment criteria).

Scenic, Recreational, and Conservation Values

Recreational and scenic values for this study are determined subjectively at each site. They can therefore reflect a personal bias of the recorders and attempts are made to reduce the potential for this to occur. The recreational value of the streams is determined by generating a spectrum of recreational opportunity and assessing potential and actual recreation types for each site surveyed (see *Appendix 1, Sheet 11*, for a description of recreational opportunity criteria). For the purpose of this survey, the various categories were classified in terms of land use, accessibility, human impact and development, expected human contact, and facilities, regulations and structures. Additionally, scenic value ratings are recorded based on features which contribute to the overall aspect of the site.

A rating for the overall scenic and recreation values of the streams is calculated by combining recreational opportunity, recorded types of recreation available at sites, and the scenic value rating. The formula rates sites with natural settings and high scenic values higher than those sites in rural and urban settings, but the value is increased at sites with a diversity of recreational types available.

The conservation merit of sites relates to three separate components which are subjectively assessed by data collectors. These components include the value of sites as habitat for aquatic plant and animal species, the value of the site as habitat for riparian plant and animal species, and the value of the site as a wildlife corridor (see *Appendix 1, Sheet 11*, for an explanation of the individual components criteria). Each site is ranked from 1 to 10 for each of the components (10 being the highest ranking).

It is considered that sites receiving very high conservation merit for any of the individual components may be worthy of some form of protective management to maintain those qualities.

Overall Condition Rating

An overall condition rating for the whole study is determined by combining the condition ratings for each of the previously discussed attributes. Each of these components is given an equal weighting, such that one component is not of greater significance than any other.

Results and Discussion

IFR Sites

Each of the Instream Flow Requirement (IFR) Sites are located within subsections. The results presented below are the summaries of the data collected for the particular subsection, which have two sites describing the features of the subsections containing IFR Sites 2, 3 and 4 and one site for IFR 1.

IFR Site 1 Logan River at Rathdowney

Reach Environs

The rating determined for this subsection indicates that the subsection is in Poor Condition, Table 2.

Land use along the stream was predominantly grazing of cattle on cleared native pastures, with the urban area of Rathdowney adjacent to the river and the town water treatment installation on the left bank. Disturbance to the reach environs was attributed to grazing activity, the previous clearing of vegetation and extraction of water from the river.

It was expected that the original vegetation cover of this area would have been eucalypt open woodland, but is now grass covered paddocks and the town of Rathdowney. Land tenure of the neighbouring properties is likely to be freehold grazing properties and urban development.

Channel Habitat

Channel habitat diversity received a rating of Moderate, Table 2, based on the varying habitats present in the stream reach. These habitat types were riffle, run and pool which comprised 30%, 35% and 35% of the stream length respectively. These habitats were generally shallow, with riffles being less than 0.1 metre deep, the run a maximum of 0.4 metre deep and the pool a maximum of 0.6 metre deep.

Table 2 IFR SITE 1 CONDITION RATINGS

	Stream Attributes									
	Reach Environs	Channel Habitat	Bank	Bed & Bar	Riparian Vegetation	Aquatic Vegetation	Aquatic Habitat	Scenic & Recreation	Conservation	Overall
Very Poor					5					
Poor	33								27	
Moderate		60		46		49		55		46
Good			75				62			
Very Good										

Bank Stability

The banks of the river received a rating of Good, indicating that they are fairly stable, Table 2. Lower stream banks had 15% of their length bare of vegetation and were recorded as stable for 75% of their length. Both erosion and aggradation were recorded as processes active on the lower banks with 20% of bank length eroding and 10% aggrading. These processes were occurring around obstructions.

Upper banks were bare of vegetation for 20% of their length, and were similarly stable for 75% of their length. Erosion was occurring along 15% of the upper bank length with significant slumping recorded along 20% of the bank length. The slumping was occurring at a bend in the stream and at irregular intervals along the stream.

Factors which were considered to be affecting the stability of the stream banks were the effects of stream flow, stock access along the banks and vegetation clearing. There were no artificial protection measures in place to stabilise the stream banks.

Bed & Bar Stability

The bed of the river within this subsection was rated as Moderately stable, Table 2. Instability of the bed was due to aggradation of sand, forming bars which covered 15% of the stream bed. The material in the bars was subangular, spherical in shape, fairly clean of algae and had low compaction, which suggested that the bed material was fairly mobile.

The effects of stock access to the stream bed was identified as the most likely impact on the material in the bed, while the presence of rock and logs would have some stabilising effect.

Riparian Vegetation

Vegetation along the stream received a Very Poor rating, Table 2. This outcome was attributable to the situation that there is virtually no vegetation along the stream. The remnant vegetation width was 3 metres, which is very small when consideration is made of the width of the upper banks was 12 metres with a slope of 33°. The vegetation that was present consisted mainly of grasses, which have been promoted for fodder for cattle and comprise significant proportions of exotic species.

The remnant riparian vegetation was mainly tall shrubs, providing cover to 45% of the stream length, of *Callistemon* species with some *Casuarina* and *Melaleuca* species present. Along the lower banks rushes provided cover to 25% of the stream length.

Aquatic Vegetation

Aquatic vegetation received a rating of Moderate, Table 2. Cover provided by this vegetation represented 70% of the stream bed. The vegetation was comprised of submerged species, mostly algae and a small percentage, 10%, of cover from *Myriophyll* species.

Aquatic Habitat

Instream habitat was provided by a fairly diverse range of materials which resulted in a condition rating of Good, Table 2. This instream habitat was comprised of substrate of cobbles, for over 30% of the reach length, individual large logs, large log snag, small branches, terrestrial leaf matter, algae and deep water.

Cover provided to the stream from bank vegetation was also of good quality with overhanging vegetation cover present along 45% of the stream length and canopy cover along 30%, extending across the channel a mean of 1.5 metres from each bank. The mean channel width, measured at the water surface was 8 metres. Cover was also provided from root and bank overhang.

Potential passage for fish along the stream was very restricted, at the time of survey, with a low weir, 0.5 metres high, present in association with a stream gauging station at the site. To bypass this barrier a stream flow at a level near two thirds of the bank full would be required.

Scenic, Recreation and Conservation Values

Scenic and recreation values of this site were considered to be Moderate, Table 2. The recreational opportunity was an Undeveloped Rural setting, with the scenic value being an appreciation of a scenic rural setting.

The Conservation value of the site was rated as Poor, as the natural systems of the stream were significantly degraded, with remnant aquatic habitat receiving a moderate value, but the value of the riparian habitat and as a wildlife corridor as nil.

Overall Condition

Combination of the condition ratings of the preceding stream attributes such that each has equal weighting produced an overall rating for this subsection of Moderate, Table 2.

IFR Site 2 Logan River at Bromilton Rock Bar

Reach Environs

The rating determined for this subsection indicates that the subsection is in Poor Condition, Table 3.

Land use along the stream in this subsection was predominately grazing of cattle, undertaken on sown pasture and on cleared native pastures, with irrigation of broadacre row crops. Disturbance to the reach environs was attributed to grazing activity, the previous clearing of vegetation and presence of road infrastructure.

It is expected that the original vegetation cover of this area would have been eucalypt woodland and eucalypt open woodland but is now grass covered paddocks. Land tenure of the neighbouring properties is likely to be freehold grazing properties.

Table 3 IFR SITE 2 CONDITION RATINGS

	Stream Attributes									
	Reach Environments	Channel Habitat	Bank	Bed & Bar	Riparian Vegetation	Aquatic Vegetation	Aquatic Habitat	Scenic & Recreation	Conservation	Overall
Very Poor					19					
Poor	33			39		26			27	46
Moderate			59				51	51		
Good		64								
Very Good										

Channel Habitat

Channel habitat diversity received a rating of Good, Table 3, based on the varying habitats present in the stream reach. These habitat types were cascade, rapid, riffle, glide, run and pool which comprised 18%, 7%, 18%, 58% and 19% of the stream length respectively. The water level within these habitats was shallow, with the rapid being 0.2 metre deep, the riffle a maximum of 0.4 metre deep, the glide a maximum of 0.2 metre deep, and the pool a maximum of 0.8 metre deep. The cascade was approximately 0.7 metre high, 20 metres long and had a slope of 10°.

Bank Stability

The banks of the streams received a rating of Moderate, Table 3. Lower stream banks had 30% of their length bare of vegetation and were recorded as stable for 45% of their length. Both erosion and aggradation were recorded as processes active on the lower banks with 33% of bank length eroding and 40% aggrading. The aggradation was occurring at bends in the stream while erosion was occurring around obstructions and along most of the stream.

Upper banks were bare of vegetation for 19% of their length, and were similarly stable for 63% of their length. Erosion was occurring along 20% of the upper bank length with aggradation recorded along 35% of the bank length. The aggradation was occurring at bends in the stream, with erosion around obstructions and at irregular intervals along the stream.

Factors which were considered to be affecting the stability of the stream banks were the effects of stream flow, stock access along the banks, the influence of people, infrastructure and vegetation clearing. There was one occurrence artificial protection measures, in the form of a rock wall, in place to stabilise the stream banks.

Bed & Bar Stability

The bed of the streams within this subsection was rated as Poor, Table 3. Instability of the bed was due to aggradation of sand, forming bars which covered 10% of the stream bed. The material in the bars was subangular, spherical in shape, fairly clean of algae and had low to very low compaction which suggested that the bed material was fairly mobile.

The effects of stock access to the stream bed and agricultural practices were identified as the most likely impact on the stability of the bed, while the presence of rock, a bridge and logs would have some stabilising effect.

Riparian Vegetation

Vegetation along the stream received a Very Poor rating, Table 3. This outcome was attributable to the situation that there is very little vegetation along the stream. The remnant vegetation had a mean width of 18 metres, which ranged from 3 to 30 metres, with riparian vegetation recorded as being a mean 8 metres wide, which ranged from 3 to 15 metres. This mean riparian vegetation width is compatible with the mean width of the upper bank which was 8 metres (ranging from 4 to 12 metres) with a slope of 65°.

The vegetation cover which was present had canopy cover provided by tall trees, 6% cover, medium trees, 38% cover, and low trees, 24% cover. These trees were *Eucalyptus*, *Casuarina*, rainforest species, *Ficus* species and Blackbean. Understorey of low and tall shrubs provided 15% and 8% cover each mostly of *Callistemon* species and had a high content of exotic species including *Lantana*. Ground cover was mostly grasses providing 65% cover, which have been promoted for fodder for cattle and comprise significant proportions of exotic species, and herds and forbs which provided 18% cover and were mostly exotic species.

Along the lower banks rushes, (*Lomandra*), provided cover to 7% of the stream length with some ferns present..

Aquatic Vegetation

Aquatic vegetation received a rating of Poor, Table 3. Cover provided by this vegetation represented 35% of the stream bed. The vegetation was comprised of algae with filamentous forms providing 65% of this cover..

Aquatic Habitat

Instream habitat was provided by a range of materials and debris which resulted in a condition rating of Moderate, Table 3. This instream habitat was comprised of substrate of rock, for over 13% of the reach length, individual large logs, large log snag, small branches, terrestrial leaf matter, algae and deep water.

Cover provided to the stream from bank vegetation was from overhanging vegetation cover present along a mean of 39% of the stream length and extending across the channel a mean of 1.4 metres from each bank. The mean channel width, measured at the water surface was 17 metres

Potential passage for fish along the stream was very restricted, at the time of survey, with a rapid, 0.4 metres high, a bridge 0.9 metres high and a log 0.6 metre, restricting passage. To bypass these barriers a stream flow at a level near one to two thirds of the bank full would be required.

Scenic, Recreation and Conservation Values

Scenic and recreation values of this site were considered to be Moderate, Table 3. The recreational opportunity was an Undeveloped Rural setting and Developed Urban (polo field), with recreation activities being polo, shore fishing, swimming and nature appreciation. The scenic value being in appreciation of a scenic rural setting and natural beauty of the river.

The Conservation value of the site was rated as Poor as the natural systems of the stream were significantly degraded, with remnant aquatic habitat receiving a moderate value, but the value of the riparian habitat and as a wildlife corridor as low.

Overall Condition

Combination of the condition ratings of the preceding stream attributes such that each has equal weighting produced an overall rating for this subsection of Poor, Table 3.

IFR Site 3 Logan River at Paynes Bridge

Reach Environs

The rating determined for this subsection indicates that the subsection is in Moderate condition, Table 4.

Land use along the stream was predominately grazing of cattle, undertaken on cleared native pastures. Disturbance to the reach environs was attributed to grazing activity, the previous clearing of vegetation and presence of road infrastructure.

It is expected that the original vegetation cover of this area would have been eucalypt woodland and eucalypt open woodland with an area of *Melaleuca* forest, but is now grass covered paddocks and rural residential properties. Land tenure of the neighbouring properties is likely to be freehold.

Table 4 IFR SITE 3 CONDITION RATINGS

	Stream Attributes									
	Reach Environs	Channel Habitat	Bank	Bed & Bar	Riparian Vegetation	Aquatic Vegetation	Aquatic Habitat	Scenic & Recreation	Conservation	Overall
Very Poor		15				1				
Poor					26		32		40	36
Moderate	50		58	43				60		
Good										
Very Good										

Channel Habitat

Channel habitat diversity received a rating of Very Poor, Table 4, based on the habitats present in the stream reach. These habitat types were glide and run. At the IFR site the channel habitat was 100% run and at the upstream site run habitat was 20% and glide 80% of the reach length. The water level within these habitats was shallow, with the glide a maximum of 0.1 metre deep, and the run habitat a maximum of 0.4 metre deep.

Bank Stability

The banks of the river received a rating of Moderate, Table 4. Lower stream banks had 23% of their length bare of vegetation and were recorded as stable for 58% of their length. Both erosion and aggradation were recorded as processes active on the lower banks, with 35% of bank length eroding and 15% aggrading. The aggradation was occurring all along the banks of the stream while erosion was occurring irregularly along the stream.

Upper banks were bare of vegetation for 18% of their length, and were similarly stable for 58% of their length. Erosion was occurring along 20% of the upper bank length, slumping along 15% of the stream, with aggradation recorded along 30% of the bank length. The aggradation was occurring all along the stream, with erosion and slumping at irregular intervals along the stream.

Factors which were considered to be affecting the stability of the stream banks were the effects of stream flow, stock access along the banks, the influence of people, infrastructure and vegetation clearing. There were no artificial protection measures in place to stabilise the stream banks.

Bed & Bar Stability

The bed of the river within this subsection was rated as Moderate, Table 4. Instability of the bed was due to aggradation of sand forming bars which covered 25% of the stream bed. The material in the bars was subangular, spherical in shape, fairly clean of algae and had low to very low compaction which suggested that the bed material was fairly mobile.

Bank erosion, the effects of stock access to the stream bed and agricultural practices were identified as the most likely impact on the stability of the bed, while the presence of rock and logs would have some stabilising effect.

Riparian Vegetation

Vegetation along the stream received a Poor rating, Table 4. This outcome was attributable to the situation that there is little vegetation along the stream. The remnant vegetation had a mean width of 33 metres, which ranged from 25 to 40 metres, with riparian vegetation recorded as being a mean 15 metres wide, which ranged from 8 to 20 metres. This mean riparian vegetation width was a little wider than the mean width of the upper bank which was 20 metres (ranging from 15 to 25 metres) with a slope of 60°.

The vegetation cover, that was present, had canopy cover provided by tall trees, 2% cover, medium trees, 15% cover, and low trees, 35% cover. These trees were *Eucalyptus*, *Casuarina*, *Ficus* species and Blackbean. Understorey of low and tall shrubs provided 7% and 29% cover each, mostly of *Callistemon* species, and had a high content of exotic species including *Lantana*. Ground cover was mostly grasses providing 50% cover, which had significant proportions of exotic species, and herbs and forbs which provided 18% cover and were mostly exotic species. Vine species were present in the riparian vegetation.

Along the lower banks *Lomandra* provided cover to 3% of the stream length with some ferns present..

Aquatic Vegetation

Aquatic vegetation received a rating of Very Poor, Table 4. The stream bed within this subsection was bare of vegetation.

Aquatic Habitat

Instream habitat was provided by a range of materials which resulted in a condition rating of Poor, Table 4. This instream habitat was comprised of substrate of sand with rock outcrop on the right bank of the IFR site, individual large logs, large log snag, small branches and terrestrial leaf matter. There was habitat provided by an artificial structure in the form of a bridge.

Cover provided to the stream from bank vegetation was from canopy, present along 28% of the reach length, overhanging vegetation cover present along a mean of 39% of the stream length and each extending across the channel a mean of 1.8 metres from each bank. The mean channel width, measured at the water surface was 22 metres

Potential passage for fish along the stream was moderately restricted, at the time of survey, although there were no particular obstacles presenting a barrier the shallowness of the flow would not allow passage.

Scenic, Recreation and Conservation Values

Scenic and recreation values of this site were considered to be Moderate, Table 4. The recreational opportunity was an Undeveloped Rural setting with recreation activities being picnicking, shore fishing, swimming, nature appreciation and teenage nocturnal activities. The scenic value being in appreciation of a scenic rural setting and natural beauty of the river.

The Conservation value of the site was rated as Poor as the natural systems of the stream were degraded, with remnant aquatic habitat receiving a moderate value, and the value of the riparian habitat and as a wildlife corridor as low to moderate.

Overall Condition

Combination of the condition ratings of the preceding stream attributes such that each has equal weighting produced an overall rating for this subsection of Poor, Table 4.

IFR Site 4 Teviot Brook at Wyaralong Dam Site

Reach Environs

The rating determined for this subsection indicates that the subsection is in Moderate condition, Table 6.

Land use along the stream was predominately grazing of cattle, undertaken on cleared native pastures and in thinned forest areas, and irrigation of broadacre row crops. Disturbance to the reach environs was attributed to grazing activity and the previous clearing of vegetation

It is expected that the original vegetation cover of this area would have been eucalypt open woodland, but is now grass covered paddocks and irrigated cropping land. Land tenure of the neighbouring properties is likely to be freehold.

Table 5 IFR SITE 4 CONDITION RATINGS

	Stream Attributes									
	Reach Environs	Channel Habitat	Bank	Bed & Bar	Riparian Vegetation	Aquatic Vegetation	Aquatic Habitat	Scenic & Recreation	Conservation	Overall
Very Poor					18					
Poor				25		31			37	
Moderate	42						60	47		43
Good		63	61							
Very Good										

Channel Habitat

Channel habitat diversity received a rating of Good, Table 5, based on the habitats present in the stream reach. These habitat types were riffle, glide, run and pool with the IFR site having channel habitat 30% of the reach length glide, 10% run, 50% pool and 10% riffle habitat. The water level within these habitats was shallow, with the riffle a maximum 0.2 metre deep, glide a maximum of 0.1 metre deep, the run a maximum of 0.9 metre deep and the pool a maximum 1.0 metre deep.

Bank Stability

The banks of the river received a rating of Good, Table 5. Lower stream banks had 78% of their length bare of vegetation and were recorded as stable for 45% of their length. Erosion, slumping and aggradation were recorded as processes active on the lower banks with 35% of bank length eroding, 10% slumping and 30% aggrading. The aggradation was occurring at bends of the stream while erosion was occurring at bends, obstacles and irregularly along the stream, and slumping was at bends and all along the stream.

Upper banks were bare of vegetation for 23% of their length, and were stable for 65% of their length. Erosion was occurring along 25% of the upper bank length and aggradation recorded along 15% of the bank

length. The aggradation was occurring at bends in the stream and erosion at bends, obstacles and irregularly along the stream.

Factors which were considered to be affecting the stability of the stream banks were the effects of stream flow, stock access along the banks and vegetation clearing. There were no artificial protection measures in place to stabilise the stream banks.

Bed & Bar Stability

The bed of the river within this subsection was rated as Poor, Table 5. Instability of the bed was due to aggradation of sand forming bars which covered 38% of the stream bed. The material in the bars was subangular, spherical in shape, fairly clean of algae and had low to very low compaction which suggested that the bed material was fairly mobile. The bars were located as point bars, around obstructions and in encroaching vegetation.

Bank erosion and the effects of stock access to the stream bed were identified as the most likely impact on the stability of the bed, while the presence of logs would have some stabilising effect.

Riparian Vegetation

Vegetation along the stream received a Very Poor rating, Table 5. This outcome was attributable to the situation that there is little vegetation along the stream. The remnant vegetation had a mean width of 17 metres, which ranged from 8 to 30 metres, with riparian vegetation recorded as being a mean 7 metres wide, which ranged from 5 to 10 metres. This mean riparian vegetation width was similar to the mean width of the upper bank which was 7 metres (ranging from 2 to 15 metres) with a slope of 40°.

The vegetation cover that was present had canopy of tall trees, 12% cover, medium trees, 28% cover, and low trees, 13% cover. These trees were *Eucalyptus* and *Casuarina* species. Understorey of tall shrubs provided 23% cover mostly of *Callistemon* species, and had a high content of exotic species including *Lantana*. Ground cover was mostly grasses providing 50% cover, which have been promoted for fodder for cattle and comprise significant proportions of exotic species, and herbs and forbs which provided 10% cover. Vine species were recorded fairly extensively in the riparian vegetation, providing a mean cover of 21% of the bank length, which had a high content of exotic species.

Along the lower banks *Lomandra* provided cover to 8% of the stream length.

Aquatic Vegetation

Aquatic vegetation received a rating of Poor, Table 5. The stream bed within this subsection was 55% bare of vegetation with the 45% cover provided by algae.

Aquatic Habitat

Instream habitat was provided by a range of materials which resulted in a condition rating of Moderate, Table 5. This instream habitat was comprised of substrate of sand, individual large logs, small branches, small branch snag, terrestrial leaf matter, root cover and a large deep pool.

Cover provided to the stream from bank vegetation was from canopy, present along 48% of the reach length, overhanging vegetation cover present along a mean of 14% of the stream length and each extending across the channel a mean of 3.5 metres and 1.8 metres from each bank respectively. The mean channel width, measured at the water surface was 4 metres

Potential passage for fish along the stream was very restricted, at the time of survey, although there were no particular obstacles presenting a barrier, the shallowness of the flow would not allow passage. Scenic, Recreation and Conservation Values

Scenic and recreation values of this site were considered to be Moderate, Table 5. The recreational opportunity was an Undeveloped Rural setting with recreation activities being shore fishing, swimming and nature appreciation. The scenic value being in appreciation of a scenic rural setting and natural beauty of the river.

The Conservation value of the site was rated as Poor as the natural systems of the stream were degraded, with remnant aquatic habitat receiving a moderate value, the value of the riparian habitat receiving poor to moderate value assessment and value as a wildlife corridor as low.

Overall Condition

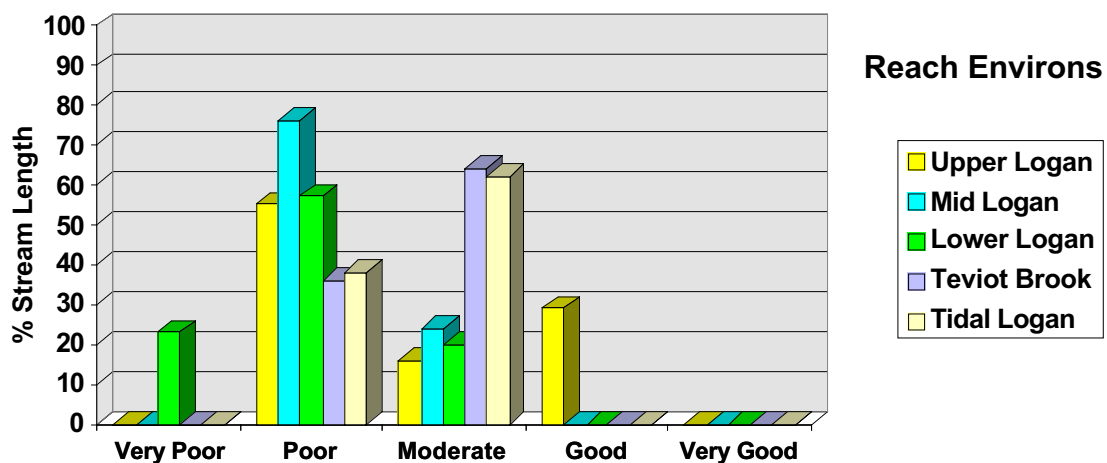
Combination of the condition ratings of the preceding stream attributes such that each has equal weighting produced an overall rating for this subsection of Moderate, Table 5.

Subcatchment Condition Assessment

Reach Environs

The condition ratings for the subcatchments are provided in Figure 1, which shows that generally the Reach Environs are in Moderate to Poor condition. There are some stream lengths in the Upper Logan subcatchment which are in Good condition and stream lengths in the Lower Logan subcatchment which are in Very Poor condition.

Figure 1 Reach Environs Condition



The higher percentages of stream length in Poor condition were in the Upper, Mid, and Lower Logan subcatchments while Teviot Brook and Tidal Logan subcatchments had higher percentages of Moderate ratings.

Land use throughout the subcatchments was predominantly grazing of both beef cattle and dairy cattle, on cleared native pastures (50% of sites), thinned forests (5%), sown pastures (24%), irrigated fodder crops (22%), sugarcane (4%), rural residential (10%), urban residential (6%) and parks and reserves (4%). The Tidal subcatchment was different in the dominant land use, with rural and urban residential, comprising the land use at 63% of sites in the subcatchment, with sugarcane production and grazing on cleared lands, each at 25% of the surveyed sites.

From this land use distribution it can be seen that the factors affecting the reach environs are related to the land use, with the effect of grazing the prime factor, along with water extraction, irrigation runoff and infrastructure and urban development.

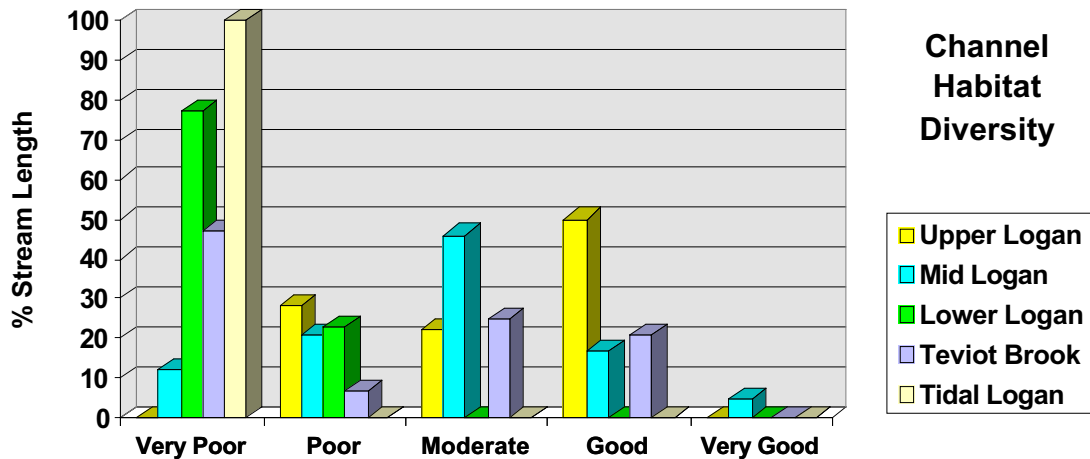
Native vegetation types across the subcatchments was recorded as dominated by eucalypt woodland and eucalypt open woodland. Vegetation in the Tidal subcatchment was more diverse due to the tidal influence and lowland nature of the area having *Melaleuca* forest, freshwater wetlands, eucalypt woodland and open woodland, mangroves and saltmarsh.

Channel Habitat Diversity

Channel habitat diversity assessment shows a slight trend through the catchment of higher diversity to lower diversity from the Upper Logan to the Tidal Logan subcatchments, Figure 2. Examination of this figure shows that the Upper Logan subcatchment has a higher percentage of stream length attributed a Good diversity rating (50% of stream length), Table 6, than all other subcatchments, with the remaining 50% spread over Moderate and Poor classifications.

The Mid Logan subcatchment has a an almost standard distribution of diversity ratings through its length with the high proportion of stream length rated Moderate, Figure 2, (46% of stream length), Table 6, but with sections both Very Good, (5% of stream length) and Very Poor, (12%). The Lower Logan subcatchment has generally Very Poor diversity, 77% of the stream length, with the remaining 23% of stream length rated Poor diversity.

Figure 2 Channel Habitat Diversity



The Teviot Brook subcatchment has a rating tending to the lower end of the scale with 47%, (Table 6), of the stream length rated Very Poor. However there are sections of the stream which are rated Moderate and Good, Figure 2. As for the Tidal Logan subcatchment it received a Very Poor diversity rating, Figure 2, for its whole length because the sites were situated in the tidal influence area thus the only habitat type recorded was pool habitat.

This general reduction of habitat types is revealed in Table 7, with the reduces number of habitat types present in the subcatchments and the trend to shallower habitats towards the mouth of the river, as shown by the more frequent occurrence of glide and run habitat, and the greater percentage of the stream reach they occupy.

Bank Stability

Bank stability ratings through the Upper Logan, Mid Logan and Lower Logan subcatchments show a slight trend from the more stable end of the scale, at the upper end of the catchment, to less stable condition at the lower end of the catchment. The Upper Logan subcatchment ranges from 9% of stream length rated Poor to 54% Good, Figure 3 and Table 6. The stream banks were considered to be stable for 63% of their length and eroding along 30%, with these processes occurring at stream bends.

The Mid Logan subcatchment has a distribution of all classifications from Very Poor, 2%, up to Good, 51%, and Very Good, 13% of stream length. The banks of the subcatchment were stable for 59% of their length and eroding along 22%. At 50% of stream banks surveyed slumping was recorded to be occurring along 27% of the bank length. Similarly at 27% of surveyed banks aggradation was taking place along 36% of the banks. The dominant process along the subcatchment stream banks was erosion along 70% of the banks and aggradation along 30%. The action of these processes were mostly recorded at bends, but with erosion also at obstacles and irregularly along the stream and slumping occurring irregularly as well.

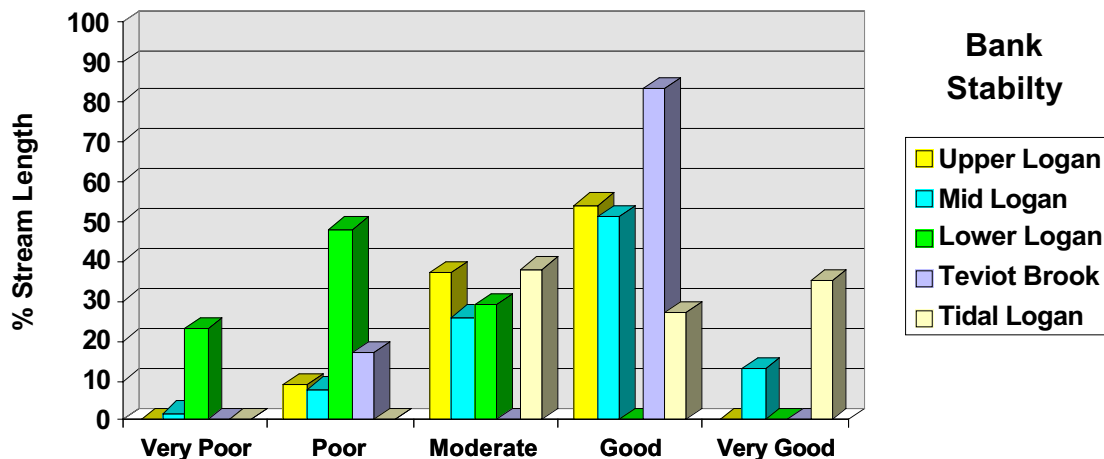
Table 6 Subcatchment Condition Ratings

Stream Attributes		Reach Environs	Channel Habitat	Bank Stability	Bed & Bar Stability	Riparian Vegetation	Aquatic Vegetation	Aquatic Habitat	Scenic & Recreation	Conservation Value	Overall Condition
	Rating	Percent of Stream Length									
Upper Logan Subcatchment	Very Poor	0	0	0	11	45	14	0	0	0	0
	Poor	55	28	9	0	11	69	0	0	6	5
	Moderate	16	22	37	64	16	6	28	45	55	61
	Good	29	50	54	0	9	11	72	41	30	34
	Very Good	0	0	0	25	20	0	0	14	9	0
Mid Logan Subcatchment	Very Poor	0	12	2	15	83	35	0	0	15	0
	Poor	76	21	8	29	4	52	25	15	39	44
	Moderate	24	46	26	28	0	13	58	44	41	43
	Good	0	17	51	0	0	0	18	41	4	13
	Very Good	0	5	13	27	13	0	0	0	0	0
Lower Logan Subcatchment	Very Poor	23	77	23	71	80	91	71	0	48	71
	Poor	57	23	48	0	20	9	20	9	52	29
	Moderate	20	0	29	20	0	0	0	91	0	0
	Good	0	0	0	9	0	0	9	0	0	0
	Very Good	0	0	0	0	0	0	0	0	0	0
Teviot Brook Subcatchment	Very Poor	0	47	0	17	68	24	17	0	7	17
	Poor	36	7	17	53	32	76	7	0	38	7
	Moderate	64	25	0	0	0	0	33	75	55	76
	Good	0	21	83	0	0	0	43	25	0	0
	Very Good	0	0	0	30	0	0	0	0	0	0
Tidal Logan Subcatchment	Very Poor	0	100	0	0	100	-	38	0	0	0
	Poor	38	0	0	0	0	-	0	27	0	65
	Moderate	62	0	38	0	0	-	27	0	100	35
	Good	0	0	27	35	0	-	35	73	0	0
	Very Good	0	0	35	65	0	-	0	0	0	0

Table 7 Channel Habitat Types

Habitat Type	Pool		Run		Riffle		Rapid		Glide		Cascade		Backwater		Mean Reach Length
Subcatchment	% of Sites	% Reach Length	% of Sites	% Reach Length	% of Sites	% Reach Length	% of Sites	% Reach Length	% of Sites	% Reach Length	% of Sites	% Reach Length	% of Sites	% Reach Length	
Upper Logan	100	53	69	30	-	-	30	23	-	4	-	20	-	-	90 m
Mid Logan	61	51	83	52	56	21	11	7	33	39	22	11	-	-	87 m
Lower Logan	-	95	50	67	-	-	-	-	66	75	-	-	-	-	160 m
Teviot Brook	70	72	60	37	30	15	-	-	50	40	10	20	20	5	110 m
Tidal Logan	100	100	-	-	-	-	-	-	-	-	-	-	-	-	275 m

Figure 3 Bank Stability



The Lower Logan subcatchment has classifications Very Poor, 23% of stream length, through Poor, 48%, to Moderate, 29%. By contrast to the two upstream subcatchments only 44% of the stream banks were stable but about the same length eroding, 28%. At 58% of stream banks surveyed slumping was recorded to be occurring along 20% of the bank length. Similarly at 58% of surveyed banks aggradation was taking place along 29% of the banks. The dominant process along the subcatchment stream banks was erosion along 100% of the banks. The action of these processes were to be acting all along the stream banks.

Teviot Brook subcatchment was predominately rated Good, 83% of stream length, with 17% classified as Poor. This is reflected in the recorded banks being 68% stable, with erosion recorded along 35% of the stream length. At 35% of stream banks surveyed aggradation was recorded to be occurring along 14% of the bank length. The action of these processes was recorded at bends and at obstacles.

Within the Tidal Logan subcatchment, which receives all the discharge, but is affected by the tidal compartment, the stream received the most stable classification, 38% Moderate, 27% Good, and 35% Very Good stability. The banks were recorded as 77% stable and 23% eroding.

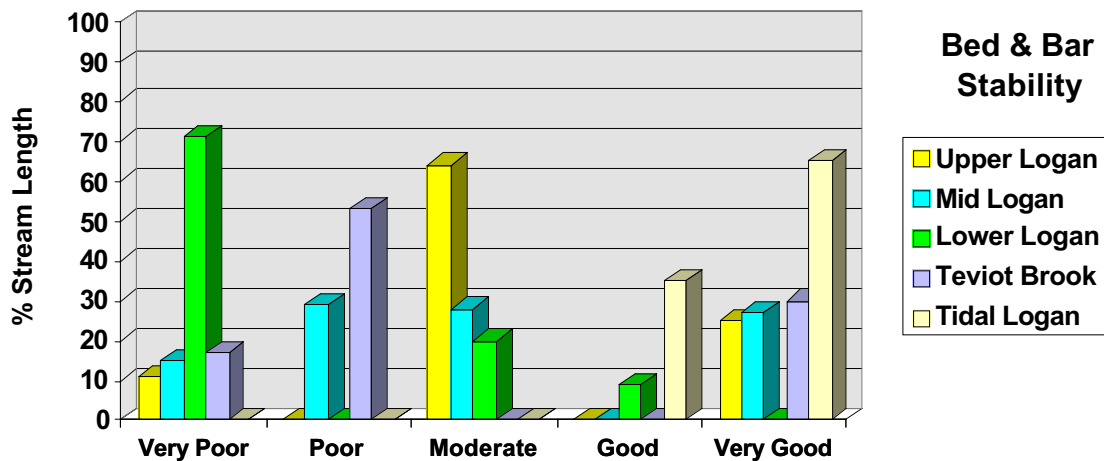
The factors which were considered to be affecting the stream banks of all subcatchments were the flow and wave action in the stream, 43% of sites, clearing of vegetation, 36%, stock access to the stream, 35%, the actions of people, 11% and infrastructure at 10% of sites.

Bed and Bar Stability

Stream bed stability ratings show a trend that the stream bed is becoming less stable the further downstream the river flows, Figure 4. The Upper Logan subcatchment is rated mostly Moderate, (64% of stream length), Table 6, but with some stream length rated Very Poor, (11%), and a greater percentage rated Very Good, (25%). The instability of the bed was due to aggradation processes with moderate aggradation recorded at 54% of sites and 46% of sites recorded as stable. Within the streams of this subcatchment bars were recorded at 85% of the sites surveyed, covering a mean 22% of the bed. The material of these bars was sand, gravel or cobbles and throughout the catchment was subangular to rounded, spherical in shape, clean of algae and low to very low compaction. The bars were recorded mostly as point bars, around encroaching vegetation, at obstructions in the bed and with high bank deposits at 2 survey sites.

Mid Logan subcatchment was generally more unstable than the Upper Logan with a greater tendency to the poorer ratings, Figure 4. This shows that 44% of stream length, Table 6, was rated Poor to Very Poor 28% Moderate and 27 % Very Good. The instability of the bed was due to aggradation processes with severe aggradation recorded at 22% of sites, moderate aggradation recorded at 61% and 17% of sites recorded as stable. Within the streams of this subcatchment bars were recorded at 89% of the sites surveyed, covering a mean 25% of the bed. The bars were recorded mostly as point bars, at obstructions in the bed and occurring alternately at 2 sites.

Figure 4 Bed & Bar Stability



The Lower Logan subcatchment tends further to the poorer stability ratings, Figure 4, with 71% of stream length rated as Very Poor, Table 6. The instability of the bed was due to aggradation processes with severe aggradation recorded at 50% of sites and moderate aggradation recorded at 50%. Within the streams of this subcatchment bars were recorded at 83% of the sites surveyed, covering a mean 43% of the bed. The bars were recorded as bar plains and at obstructions in the bed. As seen by the increase in cover of the stream bed and the type of bars present the stream is more unstable and carrying a high load of sediment.

The Teviot Brook subcatchment is similar to the Lower Logan subcatchment in its rating of stability in that the majority of the stream length is rated Poor to Very Poor, Figure 4, with 70% of the stream length in these categories, Table 6. The remaining 30% is rated Very Good. The instability of the bed was due to aggradation processes with severe aggradation recorded at 30% of sites, moderate aggradation recorded at 40% and 30% of sites recorded as stable. Within the streams of this subcatchment bars were recorded at 70% of the sites surveyed, covering a mean 44% of the bed. The bars were recorded as point bars, at obstructions in the bed and as occurring alternately.

Within the Tidal Logan subcatchment bars protruding above the water surface were not recorded thus the bed rating was Good to Very Good stability.

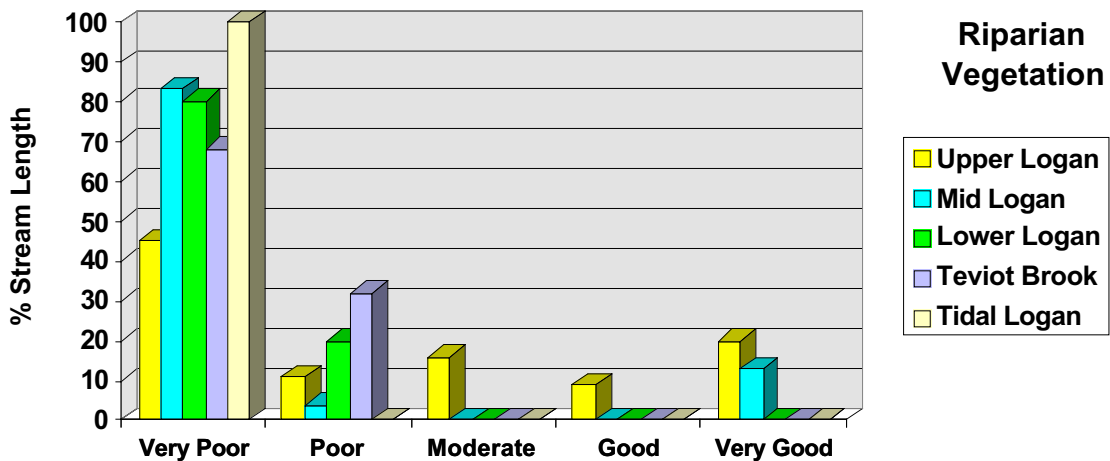
Riparian Vegetation

Riparian vegetation condition ratings across all subcatchments were mostly Very Poor, Figure 5. The Upper Logan subcatchment did have better ratings than all of the other subcatchments, with 20% of the stream length rated Very Good, 9% Good, 16% Moderate and 11% Poor, Table 6.

Within the Upper Logan subcatchment the stream banks were bare of vegetation for a mean of 9% of the bank length. The vegetation was highly disturbed having a mean remnant vegetation width of 22 metres, Figure 6, and mean riparian vegetation width of 10 metres. The structural composition of the riparian vegetation is shown in Table 8, along with the presence of exotic species in the vegetation. The most frequently recorded species are listed in Table 9.

The Mid Logan subcatchment stream banks were bare of vegetation for a mean of 11% of the bank length. The vegetation was highly disturbed having a mean riparian vegetation width of 8 metres and a mean remnant vegetation width of 13 metres, Figure 6, which shows the distribution of the remnant vegetation in the subcatchments. The structural composition of the riparian vegetation is shown in Table 8, along with the presence of exotic species in the vegetation. The most frequently recorded species are listed in Table 9.

Figure 5 Riparian Vegetation Condition



The Lower Logan subcatchment stream banks were bare of vegetation for a mean of 24% of the bank length. The vegetation was highly disturbed having a mean riparian vegetation width of 7 metres and a mean remnant vegetation width of 15 metres, Figure 6, which shows the distribution of the remnant vegetation in the subcatchments. The structural composition of the riparian vegetation is shown in Table 8, along with the presence of exotic species in the vegetation. The most frequently recorded species are listed in Table 9.

The Teviot Brook subcatchment stream banks were bare of vegetation for a mean of 11% of the bank length. The vegetation was highly disturbed having a mean riparian vegetation width of 10 metres and a mean remnant vegetation width of 15 metres, Figure 6, which shows the distribution of the remnant vegetation in the subcatchments. The structural composition of the riparian vegetation is shown in Table 8, along with the presence of exotic species in the vegetation. The most frequently recorded species are listed in Table 9.

The Tidal Logan subcatchment stream banks were bare of vegetation for a mean of 18% of the bank length. The vegetation was highly disturbed having a mean riparian vegetation width of 5 metres and a mean remnant vegetation width of 10 metres, Figure 6, which shows the distribution of the remnant vegetation in the subcatchments. The structural composition of the riparian vegetation is shown in Table 8, along with the presence of exotic species in the vegetation. The most frequently recorded species are listed in Table 9.

Figure 6 Remnant Vegetation Width

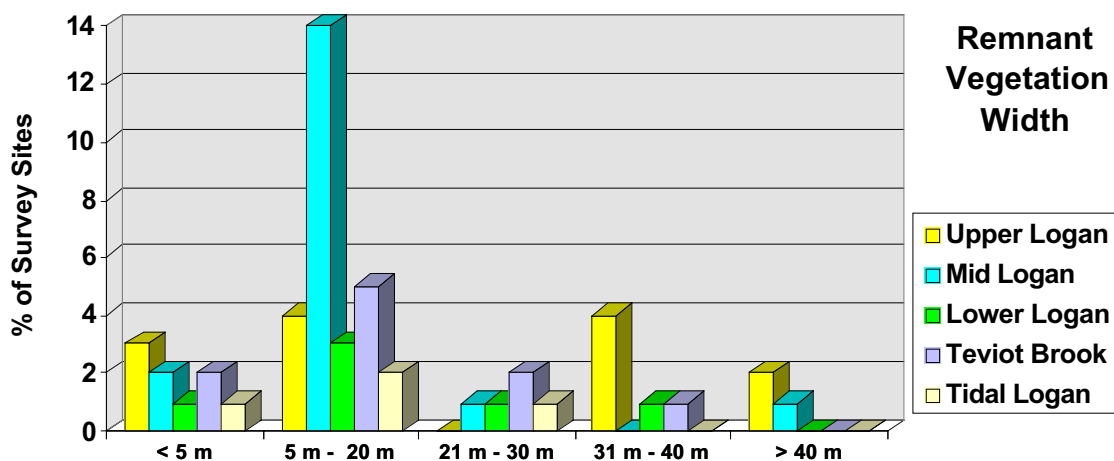


Table 8 Riparian Vegetation Characteristics

Structural Type	Upper Logan Subcatchment				Mid Logan Subcatchment			
	% Stream Banks	Mean Cover (%)	% Banks With Exotics	Mean Exotics Species (%)	% Stream Banks	Mean Cover (%)	% Banks With Exotics	Mean Exotics Species (%)
Tall Trees >30m	46	10	-	-	25	10	-	-
Medium Trees 10-30m	92	28	8	10	86	31	19	26
Low Trees <10m	100	23	8	47	100	18	31	25
Medium Shrubs >2m	50	37	15	68	69	19	25	71
Low shrubs <2m	77	13	46	96	50	9	31	98
Vines	65	11	30	76	67	13	39	94
Rushes and Sedges	96	12	-	-	92	7	-	-
Herbs and Forbs	100	22	62	95	94	21	53	87
Grasses	100	58	92	75	100	65	100	83
Ferns	58	6	-	-	31	2	-	-
Mosses	38	6	-	-	25	4	-	-

Structural Type	Lower Logan Subcatchment				Teviot Brook Subcatchment			
	% Stream Banks	Mean Cover (%)	% Banks With Exotics	Mean Exotics Species (%)	% Stream Banks	Mean Cover (%)	% Banks With Exotics	Mean Exotics Species (%)
Tall Trees >30m	33	3	-	-	40	10	-	-
Medium Trees 10-30m	75	16	-	-	90	28	5	10
Low Trees <10m	67	16	8	10	95	16	10	20
Medium Shrubs >2m	92	17	25	100	65	19	15	67
Low shrubs <2m	92	8	50	100	55	7	3	93
Vines	6	3	8	100	55	22	35	90
Rushes and Sedges	83	3	-	-	95	8	35	90
Herbs and Forbs	92	16	67	91	100	12	-	-
Grasses	100	70	100	62	100	57	95	73
Ferns	-	-	-	-	30	6	-	-
Mosses	8	1	-	-	5	1	-	-

Structural Type	Tidal Logan Subcatchment			
	% Stream Banks	Mean Cover (%)	% Banks With Exotics	Mean Exotics Species (%)
Tall Trees >30m	13	10	-	-
Medium Trees 10-30m	88	14	13	5
Low Trees <10m	75	12	-	-
Medium Shrubs >2m	38	15	-	-
Low shrubs <2m	25	23	13	80
Vines	13	30	13	90
Rushes and Sedges	38	32	-	-
Herbs and Forbs	63	22	50	85
Grasses	100	37	75	22
Mangroves	50	90	-	-
Salt Marsh	13	10	-	-

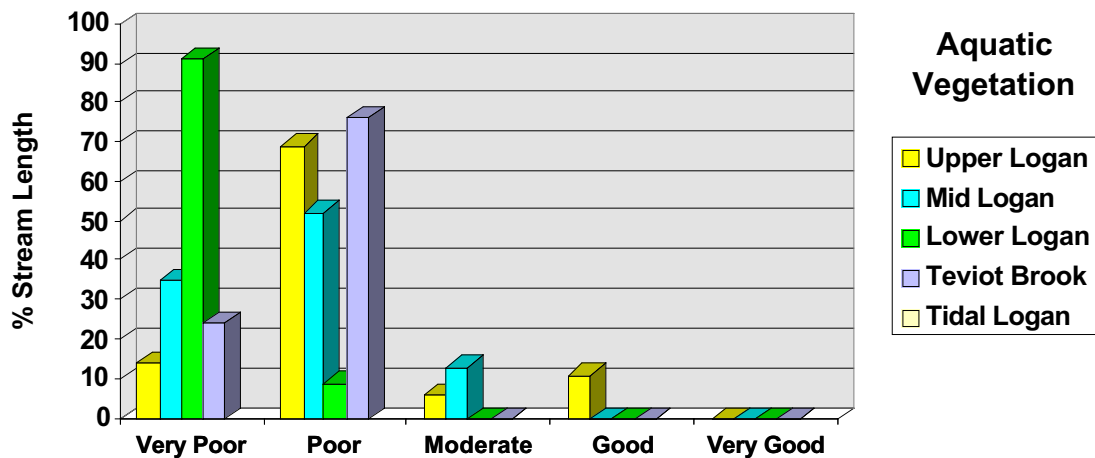
Table 9 Common Vegetation Species

Species	Subcatchments				
	Upper Logan	Mid Logan	Lower Logan	Teviot Brook	Tidal Logan
	% Sites Present				
<i>Casuarina</i>	96	92	83	85	75
<i>Callistemon</i>	85	83	83	100	75
<i>Eucalyptus</i>	69	58	67	65	50
<i>Melaleuca</i>	54	14	-	-	50
Rainforest	53	28	-	-	-
Blackbean	35	22	-	-	-
<i>Grevillia</i>	38	8	8	10	-
<i>Ficus</i> Species	46	36	33	25	25
Chinese Elm	8	11	-	15	15
Willow	-	6	-	-	-
Broad Leaf Pepper Tree	-	6	-	5	-
Champhor Laurel	-	3	-	-	-
Mulberry	-	30	17	10	-
Lantana	58	39	50	45	25
Castor Oil Plant	15	22	42	10	10
Ragweeds	23	53	33	55	55
Milkweeds	54	83	77	40	40
Thistles	58	86	17	25	25
Wild Tobacco	23	36	-	30	30
Lomandra	77	56	17	75	75
Vines & Creepers	65	53	42	60	60
Cat's Claw Vine	-	3	-	25	13
Boxthorn	12	11	8	5	-
Mangroves	-	-	-	-	50

Aquatic Vegetation

There was very little aquatic vegetation within the streams which resulted in the condition ratings listed in Figure 7, which shows that all subcatchments are rated Poor to Very Poor. The best subcatchment for aquatic vegetation was the Upper Logan, which had 11% of its stream length rated Good, Table 6.

Figure 7 Aquatic Vegetation



On the whole the streams were bare of aquatic vegetation for significant areas of the bed, Upper Logan streams were 57% bare, Mid Logan 65% bare, Lower Logan 88% bare, Teviot Brook 58% bare and there was no data for the Tidal Logan subcatchment.

Submerged vegetation was the most common growth form present, with filamentous and other forms of algae comprising most of this. The Upper Logan subcatchment had 1 site with herb like submerged forms, 1 site with *Myriophyll* species and 1 sites with *Typha* species. The Mid Logan subcatchment had 1 site with water lilies, 3 sites with *Typha* species, 2 with rushes, 1 with *Phragmites*, and 1 with para grass. The Lower Logan subcatchment had 1 site with *Typha* species, 1 with rushes and 1 with *Phragmites*. The Teviot Brook subcatchment had 1 site with herb like submerged species and 1 site with rushes and sedges.

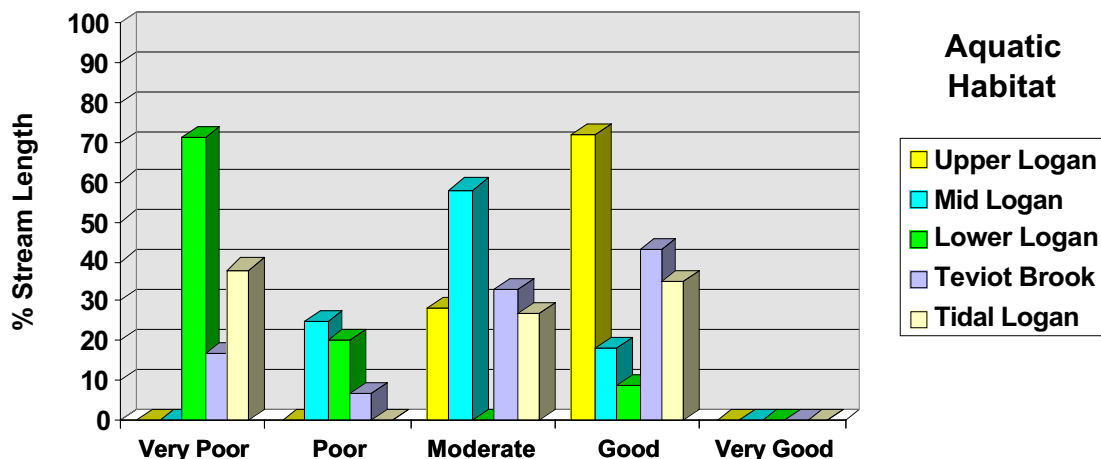
There was no data collected on the aquatic vegetation of the Tidal Logan subcatchment.

Aquatic Habitat

The condition of the aquatic habitat has a similar trend to other attributes discussed above in that the Upper Logan subcatchment had generally better ratings than the downstream subcatchments, Figure 8, with 72% of its stream length rated Good and 28% rated Moderate, Table 6. The Mid Logan subcatchment had slightly worse ratings with ratings spread over Good, Moderate and Poor, with Moderate being the dominant rating.

Ratings for the Lower Logan subcatchment were worse still with the majority of the stream length rated Very Poor. Teviot Brook and Tidal Logan subcatchments both had condition ratings distributed from Very Poor to Good but tending to have a greater proportion of the stream length rated Moderate to Good. No subcatchment had ratings of Very Good.

Figure 8 Aquatic Habitat Condition



Instream debris and bank vegetation cover combined to provide the ratings for the streams. The recorded presence, type of cover and amount of cover provided to the stream bed are provided in Table 10.

At the time of survey there was considerable restriction to the movement of fish throughout the catchment, except for the Tidal Logan subcatchment. Within the other four subcatchments movement was very restricted at 68% of the survey sites at a further 32% of sites passage was moderately restricted. Features which would impede the movement of fish were few in number at the survey site with rapids recorded at 5 sites infrastructure features at 4 sites and other low features at 4 sites. The Lower Logan subcatchment did not have any features recorded at the survey sites. The generally aggradated stream beds was the limiting factor at most site resulting in poor potential passage. There are several major weir structures on the system which were not recorded in site locations, with the most downstream weir at the boundary of fresh and salt water.

Table 10 Aquatic Habitat Characteristics

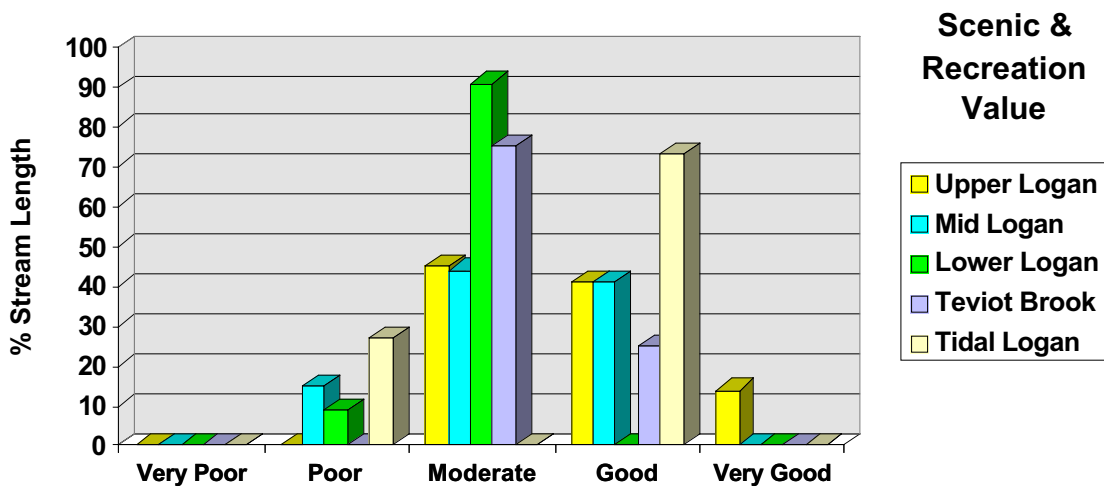
		Subcatchments									
		Upper Logan		Mid Logan		Lower Logan		Teviot Brook		Tidal Logan	
Instream Cover	Debris	% Sites	Mean Cover %	% Sites	Mean Cover %	% Sites	Mean Cover %	% Sites	Mean Cover %	% Sites	Mean Cover %
Individual Log		42	3	36	5	42	4	45	5	-	-
Log Jam <50%		23	4	17		17	3	10	3	-	-
Log Jam >50%		-	-	58	1	-	-	-	-	-	-
Individual Branch		50	6	36	3	25	5	40	3	-	-
Branch Pile <50%		27	9	33	5	8	1	25	13	-	-
Branch Pile >50%		8	3	3	1	-	-	5	5	-	-
Leaves & Twigs		42	21	47	9	25	9	35	9	-	-
Macrophyte Fragments		-	-	6	3	-	-	-	-	-	-
Algal Clumps		38	44	47	27	17	50	45	40	-	-
Submerged Vegetation		-	-	-	-	-	-	5	2	-	-
Mangroves		-	-	-	-	-	-	-	-	25	90
Floating Vegetation		-	-	-	-	-	-	-	-	-	-
Emergent Vegetation		8	11	8	7	-	-	5	5	-	-
Tree Roots		27	3	17	4	17	5	15	10	-	-
Rock Faces, Boulders		35	75	25	42	8	10	15	47	-	-
Permanent Pool > 1m		35	31	25	24	8	70	20	38	38	87
Artificial Structures		4	10	3	10	8	5	5	5	50	5
Bank Cover		% Sites	Mean Cover % & Width (m)	% Sites	Mean Cover % & Width (m)	% Sites	Mean Cover % & Width (m)	% Sites	Mean Cover % & Width (m)	% Sites	Mean Cover % & Width (m)
Canopy Cover		100	36 (3.3)	89	19 (2.3)	83	16 (2)	95	42 (2.7)	75	42 (1.7)
Vegetation Overhang		100	39 (2.3)	92	29 (1.9)	92	23 (1.7)	100	29 (2.1)	88	57 (2)
Root Overhang		69	10 (0.5)	42	7 (0.4)	50	7 (0.6)	65	10 (0.5)	75	10 (0.5)
Bank Overhang		8	3 (0.4)	-	-	-	-	5	20 (0.1)	-	-
Structure Overhang		8	5 (10)	6	5 (11)	17	5 (30)	10	2 (3)	50	4 (5.8)

Scenic, Recreation and Conservation Value

The scenic and recreation values of the subcatchments have been assessed to be Moderate to Good, Figure 9, with no stream length rated Very Poor and 14% of stream length in the Upper Logan subcatchment rated Very Good, Table 6.

Recreational opportunity was mostly in Undeveloped Rural settings, with 3 sites in Roaded Natural, 1 site Near Natural and 1 site each Developed Rural, Undeveloped Urban and Developed Urban. The recreation activities which could take place within the subcatchments was mostly shore fishing, swimming or appreciation of the local setting. There were sites in the Upper Logan subcatchment which allowed camping, picnicking, bushwalking and appreciation of nature. The Tidal Logan subcatchment had more recreation in the marine type of environment with larger boats, canoeing, sailing and water skiing.

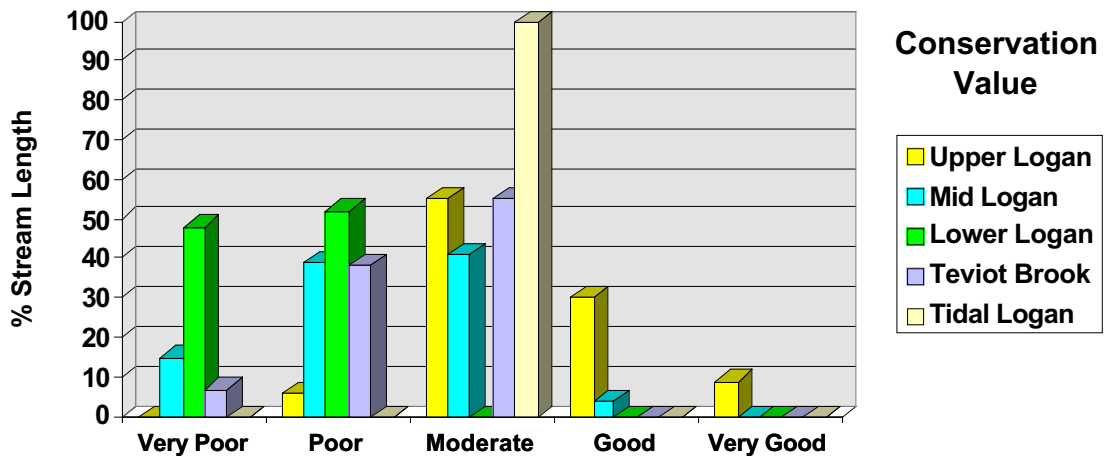
Figure 9 Scenic & Recreation Value



The conservation values assigned to the streams follows a similar pattern to other stream attributes, in that the Upper Logan subcatchment has the larger sections of stream classified in the better end of the scale, although mostly Moderate, Figure 10, there is 9% of stream length Very Good and 30% Good, Table 6.

The Mid Logan subcatchment was classified mostly Moderate as well but the remainder of the streams were classified Poor and Very Poor, while the Lower Logan was classified Poor and Very Poor. Teviot Brook subcatchment was similar to the Lower Logan subcatchment and the Tidal Logan subcatchment was classified Moderate for its whole length.

Figure 10 Conservation Value



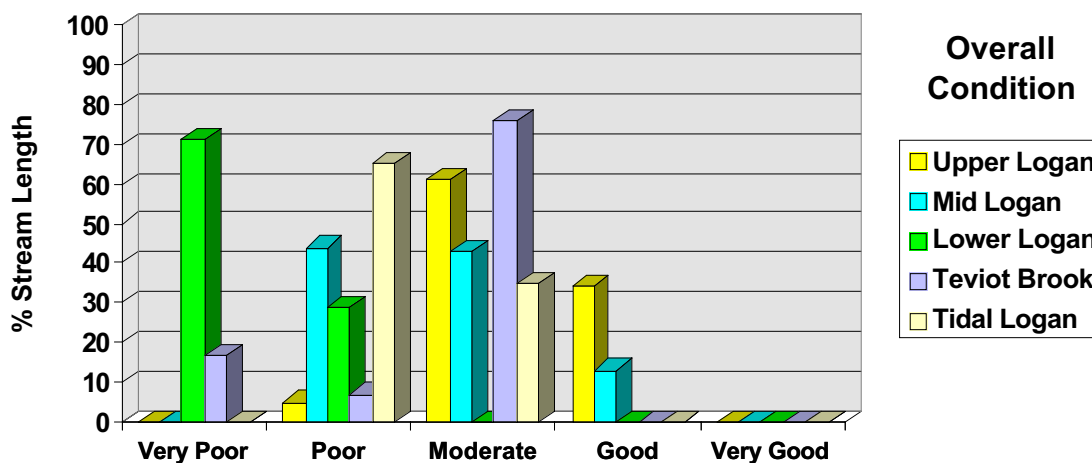
Overall Condition

The trend set in the individual stream attributes is obviously evident in the overall assessment when the attributes are combined. The Upper Logan subcatchment has the better overall assessment with the condition rating spread over the Poor, Figure 11, 5% of stream length, Table 6, Moderate, 61% and Good, 34%. Moving downstream the Mid Logan subcatchment was the next best ranging in rating from Poor to Good but with 44% of stream length classified Poor and only 13% classified Good. The Lower Logan subcatchment was all classified Very Poor and Poor, 71% and 29% of stream length respectively.

Teviot Brook subcatchment was predominantly rated Moderate, 76% of stream length, but the remainder rated Poor, 7%, and Very Poor, 17%. The Tidal Logan subcatchment was rated Poor, 65% of stream length and Moderate, 35%.

None of the streams surveyed were rated Very Good.

Figure 11 Overall Condition



Conclusions

This rapid assessment provides a broad understanding of the issues at play in the Logan River catchment in relation to physical and ecological aspects of natural resource management. The most significant factor to arise from this study has been to show that remnant vegetation along the major streams is not very well preserved for natural systems or values. The land has been cleared as close as possible to the stream banks to ensure the maximum area of agricultural production can be achieved with very little recognition of natural ecosystem requirements.

The stream banks are generally the only areas where native vegetation is retained and this is degraded significantly by uncontrolled stock access to the streams. The stream beds are aggrading to a significant extent with survey sites on tributaries of the Logan River registering sand infilled stream beds and the Lower Logan subcatchment showing similar trends with shallow wide flow and very few large, deep waterholes present in the river.

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