

## Sediment Transport In The Fitzroy River During Flood Events.

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**ABSTRACT:** *The Fitzroy River is part of a Queensland wide coordinated Sediment Sampling Program. The Fitzroy River at Rockhampton has a catchment area of 139 000km<sup>2</sup> with a mean annual runoff of 5.7 million megalitres. The major catchment activities include agriculture, grazing and coal mining.*

*Total discharge for the sampled event in March 1994 was 2.5 million megalitres, with a peak instantaneous flow of 2700 cubic metres per second.*

*Up to 2.3 tonnes of suspended sediment per megalitre of water was measured. This amounted to 3.4 million tonnes of soil for a relatively small event.*

### 1. INTRODUCTION

Sediments are an important part of a river system and can have an impact on biological habitat, flooding, pollution and our drinking water. They are a vital natural resource in some places but present a problem in others. Within the stream itself active fluvial processes take place which involve the deposition and erosion of sediments on the bed and banks. Most if not all of the sediments are transported and deposited during flood events and hence measurements must be carried out during the flood itself.

This paper examines sediment transport in the Fitzroy River at Laurel Bank near Rockhampton during a minor flood event which occurred in March 1994. Bed load, suspended sediment load, major ions and nutrients were measured. Further measurements during higher flood events are planned.

The Fitzroy River is part of a new statewide and coordinated Sediment Sampling Program established by the Queensland Department of Primary Industries (QDPI) in 1993.

Sediment monitoring is currently planned for ten key rivers in Queensland and the aims of the program are to:

- Quantify the sediment transport rate by establishment of a sediment rating curve.
- Provide reliable data for siltation studies by using improved measurement techniques.

- Determine a sustainable rate of sand and gravel extraction.
- Improve the understanding of fluvial processes.
- Quantify the amount of sediment export or erosion from a catchment.
- Provide water quality data including nutrients during flood events.

This program provides a package for sediment sampling taking into account many factors involved in the whole spectrum of data collection. QDPI has developed and implemented several improved and efficient sampling techniques in this field. These improvements include a weighing system for field determination of dry weight of bedload and modification of stream gauging equipment to allow sediment sampling to take place in conjunction with current meter measurements.

### 2. FLOOD EVENT MEASURED

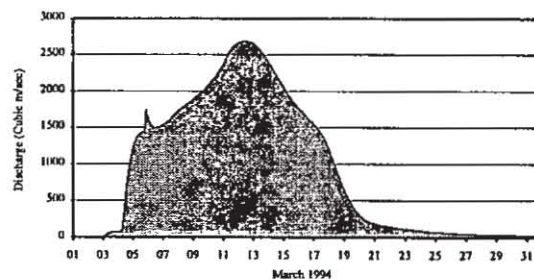


Figure 1. Discharge Hydrograph Fitzroy River At Laurel Bank

The Fitzroy River at Rockhampton has a catchment area of 139 000km<sup>2</sup> with a mean annual runoff of 5.7 million megalitres. Its catchment consists of five major sub-basins, the Mackenzie, Nogoia, Dawson, Isaac, and Comet Rivers. The major catchment activities include agriculture, grazing and coal mining.

In this paper we report the sediment load of the Fitzroy River during a small flood event in March 1994. Total discharge for the sampled event was 2.5 million megalitres, with a peak instantaneous flow of 2700 cubic metres per second. This represents an annual return interval of 1 in 2 years in the Fitzroy River. The majority of runoff originated in the Dawson, Mackenzie and Nogoia River sub basins, following an extended dry period of 3 years.

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Multipoint samples were taken at six verticals across the stream using a boat mounted USGS P61 point suspended sediment sampler. Bedload samples were also taken at the same six locations using a Helley Smith bed load sampler. Samples were analysed by Queensland Health, Scientific Services and QDPI's Rocklea Soils Laboratory.

During the flood event measured at Laurel Bank, about 3.4 million tonnes of sediment was exported.

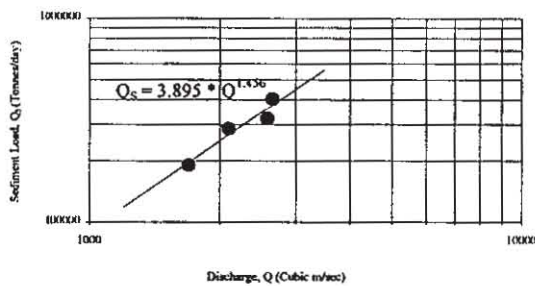


Figure 2. Sediment Rating Curve Fitzroy River at Laurel Bank

Sediment rating curve, relating streamflow (Q, cubic m/sec) to the Sediment Discharge (Q<sub>s</sub>, Tonnes/day) is defined by:

$$Q_s = 3.895 Q^{1.456}$$

Coefficient of determination:

$R^2 = 0.92$  which is a good correlation for sediment transport.

### 3. SPATIAL VARIATION OF SEDIMENT CONCENTRATION

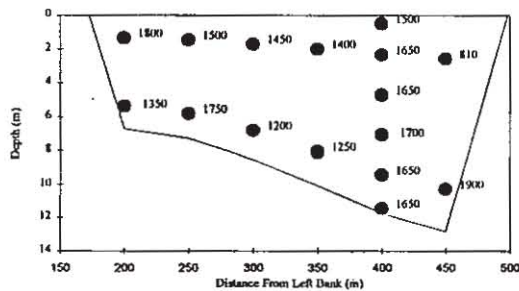


Figure 3. Distribution of Sediment Concentration Suspended Solids in mg/litre Fitzroy River at Laurel Bank Date of Sampling: 12/03/1994

The measurement program allows for detection of spatial variation in sediment concentration within a cross-section. The ratio between the maximum and minimum suspended sediment concentration is about 2 within a cross section.

### 4. DISTRIBUTION OF SEDIMENT SIZES

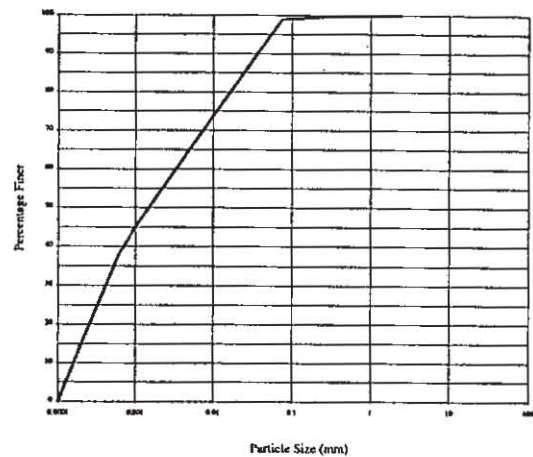


Figure 4. Particle Size Analysis Fitzroy River at Laurel Bank Date of sampling: 12/03/1994

- At stream discharges below 2700 cubic metres/sec, practically all sediment was transported as suspended load.
- Particle size of suspended sediment load generally becomes finer towards the surface.
- Suspended sediment samples are made up of:
  - 3% sand
  - 44% silt
  - 53% clay

### 5. SEDIMENT LOAD 1965 - 1994

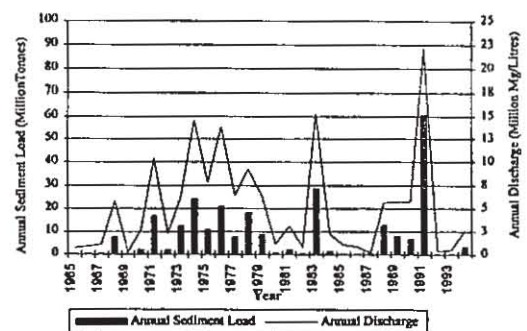


Figure 5. Annual Sediment Load And Discharge

The sediment rating curve, was applied to instantaneous streamflow information for the Fitzroy River.

Based on the sediment rating curve:

- About 264 million tons of sediment load was exported from the Fitzroy River basin over the last 30 years (1965-1994), or 8.8 million tons per year.
- An average of 0.65 tonnes/hectare per year or 64.6 tonnes/sq km per year.

## 7. CONCLUSIONS

- Total sediment exported from the Fitzroy River during the March 1994 flood event was 3.4 million tonnes.
- Sediment rating curve for the Fitzroy River at Laurel Bank is defined by  $Q_s = 3.895 Q^{1.456}$
- About 264 million tonnes of sediment has been exported from the Fitzroy River catchment over the last 30 years (1965-1994).
- Average sediment yield of the Fitzroy River catchment is 8.8 million tonnes per year or 64.6 tonnes per square km per year.
- Bedload results showed that sand and gravel of larger than 1.2mm diameter was not mobile at this site during this event. This is of significance to local extractive industry which relies on regular replenishment of sand and gravel to maintain industry sustainability at this site.
- Sediment concentration varies considerably within the cross section at this site. The ratio between the maximum and minimum suspended concentration is about 2. Lower concentrations generally occur close to the stream banks. Higher concentrations generally occur in the the stream centre.
- A sediment measurement program must be carefully designed to ensure reliable results. It should also consider the spatial variation in sediment concentration within the cross section.
- A single point measurement of sediment concentration or turbidity reading which is commonly used may lead to incorrect total sediment load being computed and hence incorrect conclusions. Multipoint samples taken throughout the stream cross section will give more accurate results.
- Further sediment measurements during higher flood events in the Fitzroy River are planned to validate the sediment rating curve. Linkages to land use and catchment condition at the time of sampling will also be explored.

## 7. ACKNOWLEDGMENTS

The contribution of hydrographic staff in Rockhampton in carrying out the field work is acknowledged.

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