

Suspended Sediment Monitoring Report 2007

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1 Introduction

Information for the sustainable management of the regions resources requires ongoing monitoring of various environmental parameters. The collection of suspended sediment data from a selection of the regions waterways allows for the estimation of sediment yields to be determined. This information is available to contribute to the development and prioritisation of land management strategies.

The following technical report describes the current methods used as part of the regional suspended sediment monitoring programme, with results collected prior to 31 December 2007 included. Information is provided for 23 regional monitoring sites. These sites consist of 15 manual gauging sites and 8 sites where we use automatic samplers (ISCO sites).

2 Monitoring methods and analysis

2.1 Manual gaugings

Manual gauging samples are collected routinely and during events to ensure that a range of samples are accumulated at various flows. A DH49 is used to obtain sediment samples when doing bridge and cable gaugings.

2.2 ISCO automatic samplers

ISCOS take samples once the water level reaches a pre-determined level. They will take 24 samples at a set interval (e.g. hourly). The ISCOS are rotated every few years depending on how much data has been obtained.

Periodically the data collected by the ISCOS are calibrated with the whole river cross-section. This is achieved by conducting manual gaugings concurrently with an ISCO operation. No calibrations have been completed during the past year.

2.3 Sample analysis

The samples from both the manual gaugings and the ISCOS are analysed at the Council's contract laboratory (R.J Hill Laboratories). Turbidity is analysed using a Hach 2100N Turbidity meter. Total suspended solids are analysed using the gravimetric method. Suspended sediment is estimated as the inorganic portion of suspended solids. Total suspended solids comprise inorganic and organic components. Generally the inorganic component makes up most of the total suspended solids and is used to estimate suspended sediment.

2.4 Turbidity sensor trial

Continuous data collected using turbidity sensors can be used as a surrogate for event based suspended sediment sampling. Turbidity sensors (Greenspan TS-100) have previously been trialled at the Waitomo (1999-2003) and Otewa (2000-2003) monitoring sites with limited success due to bio-fouling of the sensor optics. A trial has been set up in order to reassess the methods for collecting time series (continuous) data using improved turbidity sensors. In 2007 a DTS-12 turbidity sensor (Forest Technology Systems, Canada) with a calibrated range of 0-1600 Nephelometric Turbidity Units (NTUs) were installed at the Waingaro monitoring site. NTUs are an optical measure of how light is scattered by suspended particles in the water. The DTS-12 sensor has wiper blades that clean the optics window, which has improved its functionality. The trial has been underway for 12 months and will continue until sufficient data has been collected in order to evaluate the ongoing use of turbidity sensors.

2.5 Data analysis

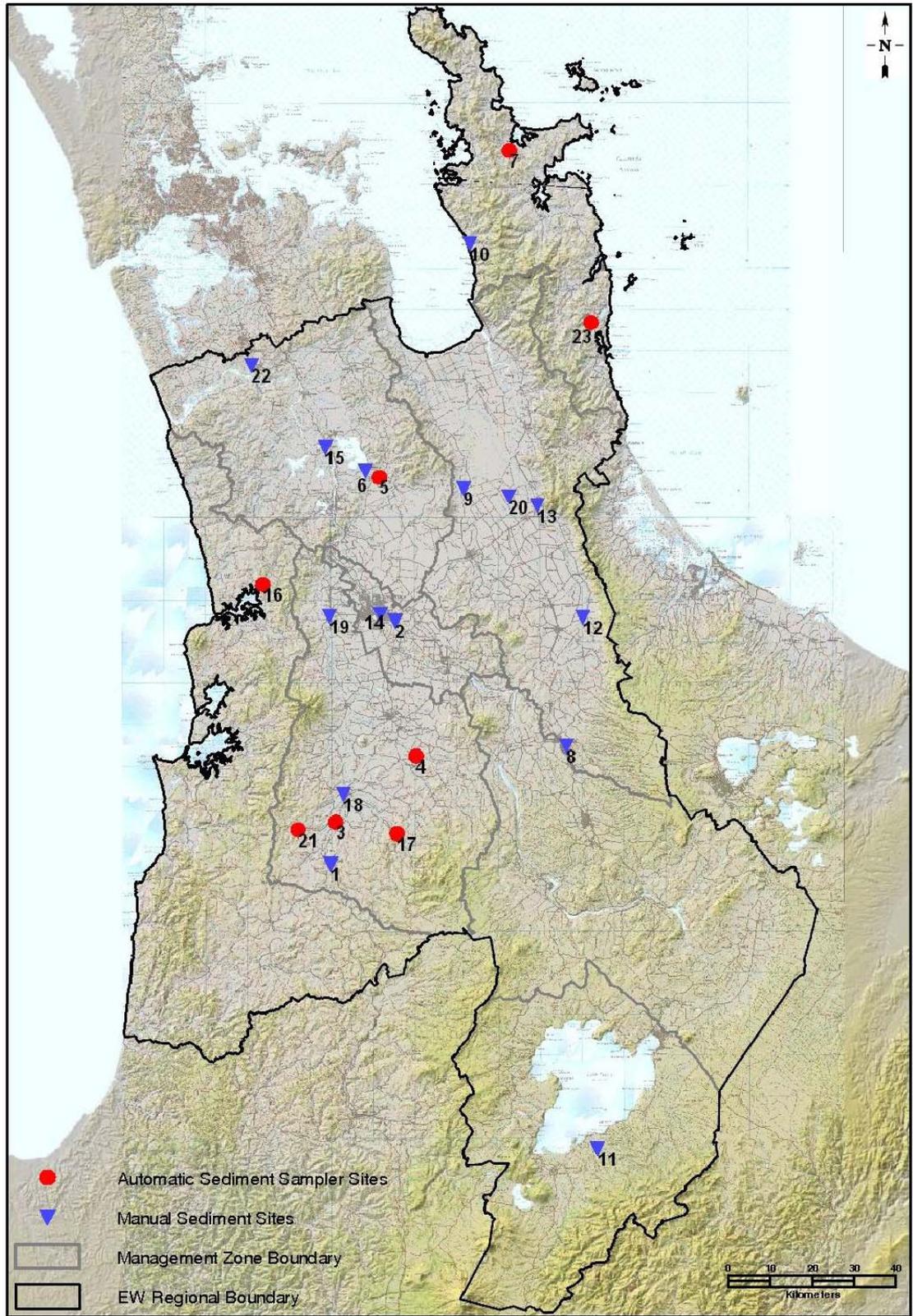
Flow and sediment data for each site was analysed using the Sedrate suspended sediment analysis tool to provide annual average sediment yields and mean concentrations. Within Sedrate four automated analysis methods are used to obtain sediment ratings for a particular site. These ratings are then applied to the site flow distribution to derive an annual sediment yield and mean concentration. Sedrate also provides information which can be used to check the reliability of the rating, yield and concentration results. There is a variation with the quantity of sediment gaugings completed at each site, which causes a greater error in the data when comparing sites. In addition annual specific yields are calculated for each site, measured in kilotonnes per kilometre squared per year (kt/km²/yr). This information provides for greater comparison of sediment yield between sites as it is relative to the catchment size.

Plots are produced by Sedrate indicating the relationship between the sediment concentration and flow for each site. A description of the plot window as produced by Sedrate can be seen in Appendix 1. A glossary of terms for Sedrate is provided in Appendix 1.

3 Site locations and samples

We currently have 23 monitored sites. A regional map illustrating the location of these sites is shown in Figure 1. The site names and associated source and location names are listed in Table 1. Table 2 summarises the quantity of sediment data currently available for both ISCO site and manual gauging sites. There are 15 manual gauging sites and 8 ISCO sites, 6 of which currently have ISCOs installed. The two ISCO sites which are not currently equipped with samplers but have been previously are Waitomo and Wharekawa. These will be reinstalled sometime in the future.

From the 23 current sites, 6536 samples have been collected and analysed to date. There have been 233 events sampled by ISCOs since the start of the programme. There were 296 samples collected in 2007, and a total of 14 events were sampled by ISCOS.



| | | |
|---|---|---|
| <p>Manual Sediment Sites</p> <p>Created by: Philippa Status: Complete Projection: NZTM Request No.: 17098 Date: 25/08/2008 File name: 17058CatchmentsSallyG</p> | <p>A4</p> <p>ACKNOWLEDGEMENTS AND DISCLAIMERS The catchment boundary is a watershed delineation and has no relationship to Environment Waikato's Regional boundary, or to any property boundaries. This catchment boundary is not an Environment Waikato legal boundary. The boundary has been captured from the NZMS260 map sheet series and is accurate to +/- 200 metres at best. The boundary is very subjective in areas with sinkholes, underground streams or drains. The boundary is not suitable for use in detailed, property-specific analysis. Digital Elevation Model layers derived by Environment Waikato. Topographic information derived from Land Information New Zealand's data. COPYRIGHT RESERVED. Environmental Data Location information sourced from Environment Waikato database and may be subject to Privacy regulations. COPYRIGHT RESERVED.</p> |  |
|---|---|---|

Figure 1: Map of current manual gauging sites and ISCO automatic sampler sites (refer to Table 1 for site names).

Table 1: Current manual gauging sites and ISCO sites (refer Figure 1)

| Reference number | Site name | Source | Location |
|------------------|----------------------|----------------------|----------------------------------|
| 1 | Mangaokewa | Mangaokewa River | Te Kuiti Pumping Station |
| 2 | Mangaonua | Mangaonua River | Dreadnought Culvert SH1 |
| 3* | Mangapu | Mangapu River | SH3 Br U/S Mangaokewa Confluence |
| 4* | Mangatutu | Mangatutu Stream | Walker Rd Br |
| 5** | Matahuru | Matahuru Stream | Myjers |
| 6* | Matahuru (Waiterimu) | Matahuru Stream | Waiterimu Road |
| 7* | Opitonui | Opitonui River | D/s Awaroa Confluence |
| 8 | Oraka | Oraka Stream | Pinedale |
| 9 | Paeroa-Tahuna | Piako River | Paeroa-Tahuna Rd Br |
| 10 | Tapu | Tapu River | Tapu-Coroglen Rd |
| 11 | Tauranga-Taupo | Tauranga-Taupo River | Te Kono Slackline |
| 12 | Okauia | Waihou River | Okauia |
| 13 | Te Aroha | Waihou River | Te Aroha |
| 14 | Hamilton Traffic | Waikato River | Hamilton Traffic Br |
| 15 | Rangiriri | Waikato River | Rangiriri Br |
| 16* | Waingaro | Waingaro River | Ruakiwi Rd off SH22 |
| 17* | Otewa | Waipa River | Otewa |
| 18 | Otorohanga | Waipa River | SH31 Br Otorohanga |
| 19 | Whatawhata | Waipa River | SH23 Br Whatawhata |
| 20 | Mellon Rd | Waitoa River | Mellon Rd Recorder |
| 21* | Waitomo | Waitomo Stream | Aranui Caves |
| 22 | Whakapipi | Whakapipi Stream | SH22 Br |
| 23* | Wharekawa | Wharekawa | Adams Farm Bridge |

× A new sediment monitoring site for Matahuru Stream (Myjers) has been established upstream where the flow is not impacted upon by the lake level. The Matahuru Stream site at Waiterimu Road is retained for manual gaugings under flood conditions only. In lower flow conditions the stream flow at this point is affected by the varying level of Lake Waikare and as such it is not possible to calculate sediment yield.

* ISCO sites.

Table 2: Summary of sediment data available from manual gauging and ISCO sites as at 31 December 2007

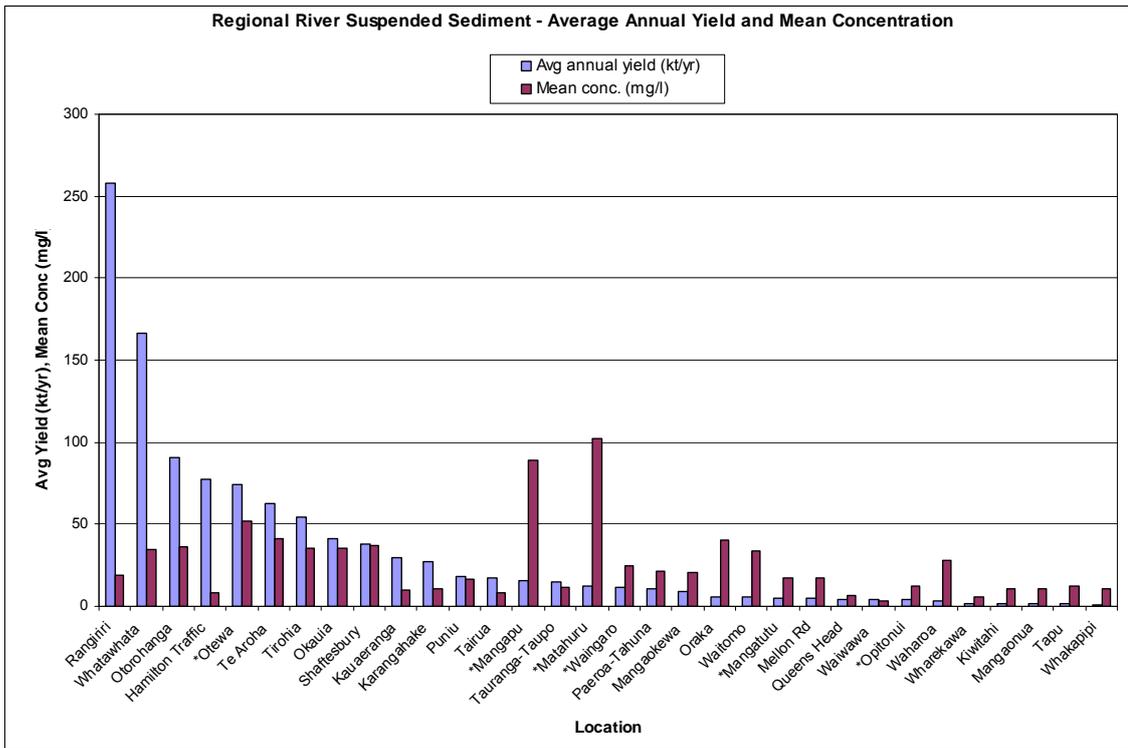
| Ref no. | Site name | No. of manual gaugings | No. of events sampled by the ISCO | No. of samples collected by the ISCO | Total no. of samples for the site |
|---------|------------------|------------------------|-----------------------------------|--------------------------------------|-----------------------------------|
| 1 | Mangaokewa | 88 | – | – | 88 |
| 2 | Mangaonua | 73 | – | – | 73 |
| 3 | Mangapu | 2 | 39 | 887 | 889 |
| 4 | Mangatutu | 7 | 30 | 615 | 622 |
| 5 | Matahuru | 3 | 14 | 239 | 242 |
| 7 | Opitonui | 64 | 52 | 1140 | 1204 |
| 8 | Oraka | 34 | – | – | 34 |
| 9 | Paeroa-Tahuna | 162 | – | – | 162 |
| 10 | Tapu | 28 | – | – | 28 |
| 11 | Tauranga-Taupo | 77 | – | – | 77 |
| 12 | Okauia | 100 | – | – | 100 |
| 13 | Te Aroha | 44 | – | – | 44 |
| 14 | Hamilton Traffic | 57 | – | – | 57 |
| 15 | Rangiriri | 66 | – | – | 66 |
| 16 | Waingaro | 8 | 31 | 667 | 675 |
| 17 | Otewa | 65 | 21 | 523 | 588 |
| 18 | Otorohanga | 9 | – | – | 9 |
| 19 | Whatawhata | 81 | – | – | 81 |
| 20 | Mellon Rd | 188 | – | – | 188 |
| 21 | Waitomo | 87 | 27 | 686 | 773 |
| 22 | Whakapipi | 58 | – | – | 58 |
| 23 | Wharekawa | 53 | 19 | 425 | 478 |

4 Results

Table 3 summarises sediment yield, concentration data and specific yield available for all sites which are currently monitored. A plot of the average annual yield and the mean concentration data is illustrated in Figure 2. A plot of the specific yields can be seen in Figure 3. Individual site results are detailed in Appendix 2.

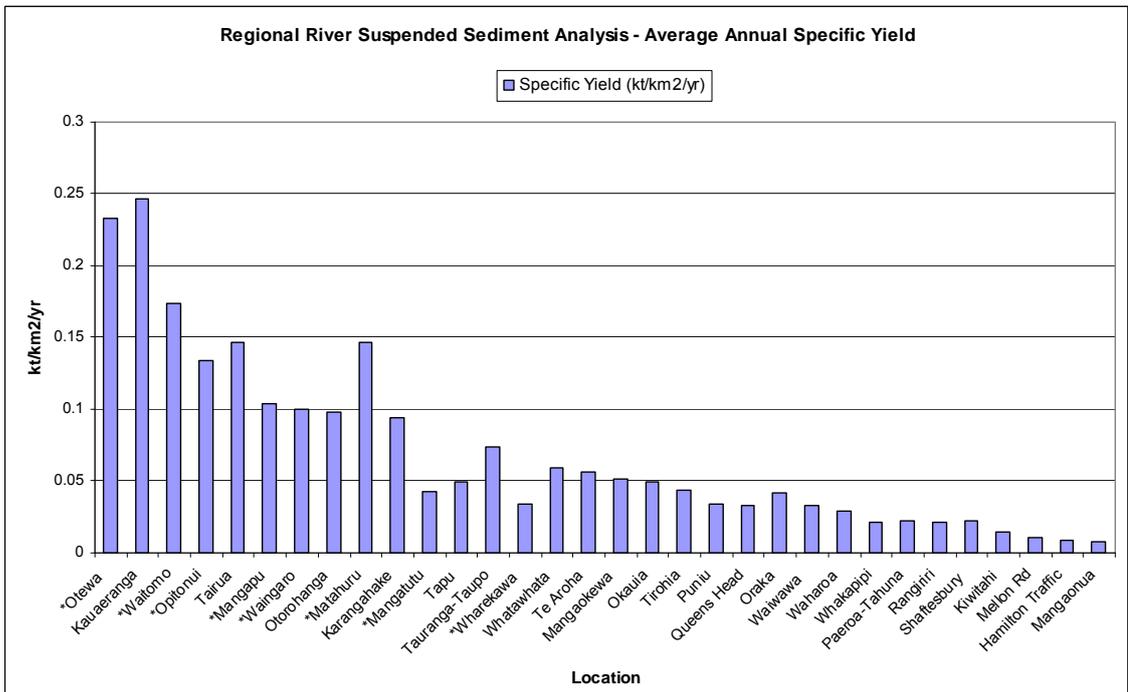
Table 3: Summary sediment yield and concentration data as at 31 December 2007

| Ref no. | Site name | Catchment area (km ²) | Avg annual yield (kt/yr) | Yield range (kt/yr) | Mean conc. (mg/l) | Specific Yield (kt/km ² /yr) |
|---------|------------------|-----------------------------------|--------------------------|---------------------|-------------------|---|
| 1 | Mangaokewa | 172 | 8.8 | 8.4 to 9.0 | 21 | 0.051 |
| 2 | Mangaonua | 166 | 1.4 | 1.2 to 1.4 | 10.8 | 0.008 |
| 3 | Mangapu | 151 | 15.7 | 11.7 to 18.0 | 89 | 0.104 |
| 4 | Mangatutu | 122 | 5.2 | 4.8 to 5.3 | 17.2 | 0.043 |
| 5 | Matahuru | 83 | 12.2 | 12.1 to 12.5 | 102.1 | 0.147 |
| 7 | Opitonui | 29 | 3.9 | 3.8 to 4.0 | 12.1 | 0.134 |
| 8 | Oraka | 136 | 5.7 | 5.0 to 6.9 | 40.5 | 0.042 |
| 9 | Paeroa-Tahuna | 491 | 10.9 | 10.4 to 11.1 | 21.7 | 0.022 |
| 10 | Tapu | 26 | 1.3 | 0.7 to 2.3 | 12.2 | 0.05 |
| 11 | Tauranga-Taupo | 197 | 14.5 | 11.5 to 19.2 | 11.4 | 0.074 |
| 12 | Okauia | 816 | 41.2 | 39.5 to 43.7 | 35.1 | 0.05 |
| 13 | Te Aroha | 1109 | 62.5 | 59.9 to 67.9 | 41.1 | 0.056 |
| 14 | Hamilton Traffic | 8230 | 77.2 | 65.5 to 84.9 | 8.6 | 0.009 |
| 15 | Rangiriri | 12421 | 258.2 | 243.8 to 265.0 | 19.2 | 0.021 |
| 16 | Waingaro | 118 | 11.8 | 11.4 to 12.7 | 24.8 | 0.1 |
| 17 | Otewa | 319 | 74.3 | 60.7 to 95.9 | 51.6 | 0.233 |
| 18 | Otorohanga | 919 | 90.5 | 87.0 to 92.9 | 35.9 | 0.098 |
| 19 | Whatawhata | 2830 | 166.3 | 157.2 to 175.1 | 34.5 | 0.059 |
| 20 | Mellon Rd | 420 | 4.7 | 4.6 to 5.1 | 17.5 | 0.011 |
| 21 | Waitomo | 31 | 5.4 | 5.1 to 5.6 | 33.7 | 0.174 |
| 22 | Whakapipi | 42 | 0.9 | 0.5 to 1.4 | 10.8 | 0.021 |
| 23 | Wharekawa | 47 | 1.6 | 4.9 to 6.0 | 5.7 | 0.034 |



* denotes ISCO automatic sampler sites

Figure 2: Average annual yields and mean concentrations



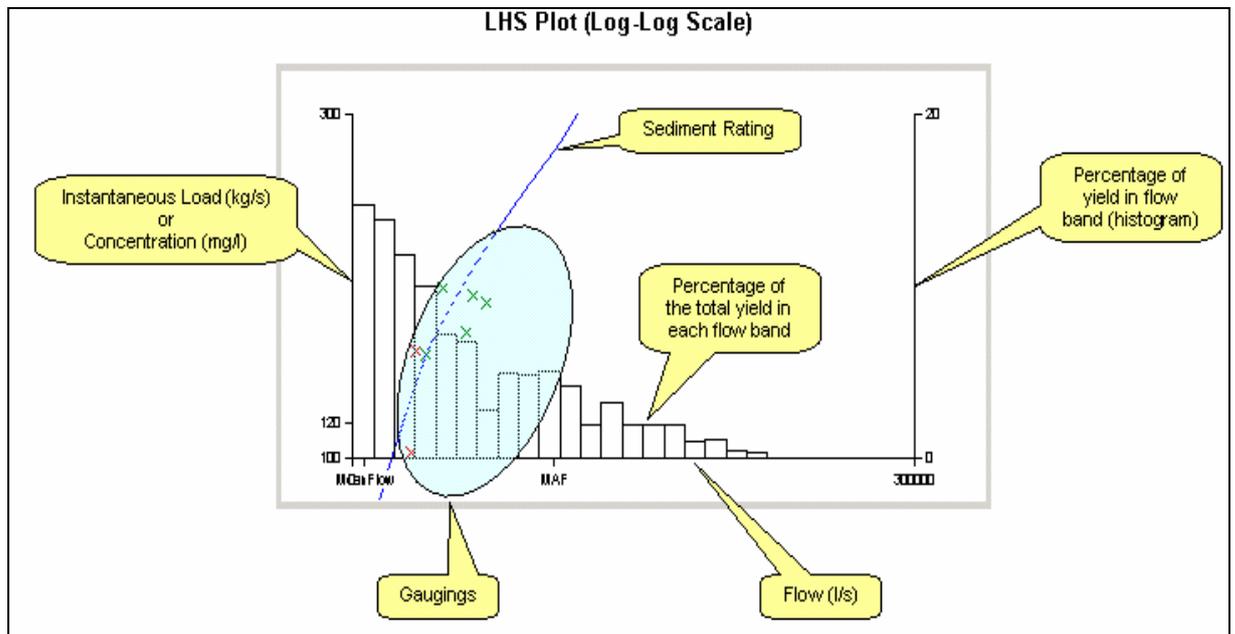
* denotes ISCO automatic sampler sites

Figure 3: Average annual specific yields

5 Conclusions

- There are currently 23 suspended sediment gauging sites, consisting of 15 manual gauging sites and 8 ISCO automatic sampler sites.
- There have been no new sites added or reinstated this year.
- A total of 296 samples were collected in 2007, including 14 events sampled by ISCOs.
- The highest average annual yield was 258 kt/yr in the Waikato River at Rangiriri Bridge.
- The lowest average annual yield was 0.9 kt/yr in the Whakapipi Stream at SH22 Bridge.
- The highest mean concentration was Matahuru, with a result of 102.1 mg/l.
- The lowest mean concentration was Wharekawa, with a result of 5.7mg/l.
- The highest specific yield was Otewa, with a result of 0.233 kt/km²/yr.
- The lowest specific yield was Mangaonua, with a result of 0.008 kt/km²/yr.

Appendix 1. Plot window information and glossary of terms for Sedrate



Sedrate plot window

As illustrated in the figure above, the plot for each site in Appendix 2 combines the following information:

- histogram of yield by flow band, expressed as a percentage of total yield (RHS Axis)
- scatter plot of gauging data
- sediment rating
- sediment concentration (mg/l)

Glossary of terms:

- **OLS (Ordinary Least Squares)** - Provides a 'best-fit line' that minimums the squares of the residuals
- **Minimum variance** - Uses the Minimum Variance Unbiased Estimator (MVUE) procedure which has a built-in log-transformation bias correction procedure.
- **Load weighted** - Uses an interactive weighted regression approach, assigning weights to each data point according to how much of the total suspended sediment load the particular discharge band transports.
- **LOWESS** – Fits a "moving" least-squares regression model to a window of the data centred on each data point
- **QMLE (Quasi-Maximum Likelihood Bias Correction)** – Bias correction where s is the standard error of the sediment rating in log units ($BCF = \exp(s^2/2)$).
- **Smearing** - Bias Correction where e are the rating residuals (log values) and n is the number of data points ($BCF = \sum \exp(e)/n$).

Appendix 2. Individual site information

Site 1: Mangaokewa River - Te Kuiti Pumping Station

Site Information

| | | | |
|-------------|------------|----------------------------------|-------------|
| Location: | Te Kuiti | Map Ref (NZMS260): | S16:997-162 |
| Located no: | 414.13 | Upstream Catchment Area (sq km): | 172 |
| Source: | Mangaokewa | | |

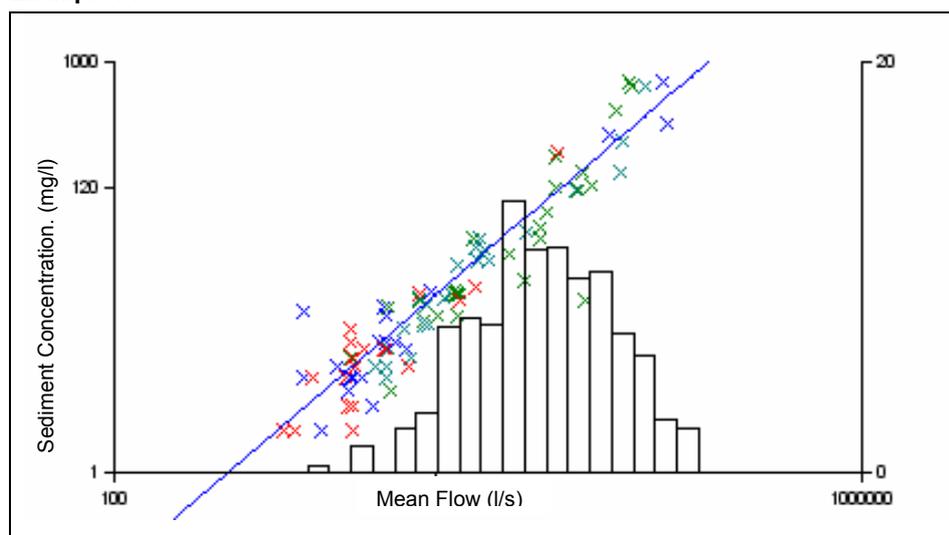
Data Information

| | Start Date | End Date |
|------------------------|------------|------------|
| Flow Time Series | 3/03/1983 | 31/12/2007 |
| Sediment Gaugings (88) | 7/08/1990 | 21/06/2004 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 8.8 | 21.4 | 97.3 | 8.7 |
| | Smearing | 8.8 | 21.3 | 97.3 | 8.7 |
| Min Variance | n/a | 8.8 | 21.3 | 97.3 | 7.9 |
| Load Weighted | QMLE | 8.4 | 20.3 | 97.3 | 8.7 |
| | Smearing | 8.8 | 21.3 | 97.3 | 8.7 |
| LOWESS | QMLE | 9.0 | 20.8 | 96.8 | 8.9 |
| | Smearing | 9.0 | 20.7 | 96.8 | 8.9 |
| | Parameter averages | 8.8 | 21.0 | 97.2 | 8.6 |
| Specific yield (kt/km²/yr) | 0.051 | | | | |

Example Plot



Plotted Yield Method: Load Weighted - Smearing

Comments

The results for average sediment yield at Te Kuiti Pumping Station range from 8.4 to 9.0 kt/yr, with the error in the yield estimate ranging from 7.9 to 8.9%. The mean suspended sediment concentration ranges from 20.3 to 21.4 mg/l and the specific yield is 0.051 kt/km²/yr.

68.8% of the flow range has been gauged with an average of 97.2% of the sediment yield occurring within this gauged range of flow.

Site 2: Mangaonua River - Dreadnought Culvert SH1

Site Information

Location: Dreadnought Map Ref (NZMS260): S14:154-748
 Located no: 421.4 Upstream Catchment Area (sq km): 166
 Source: Mangaonua

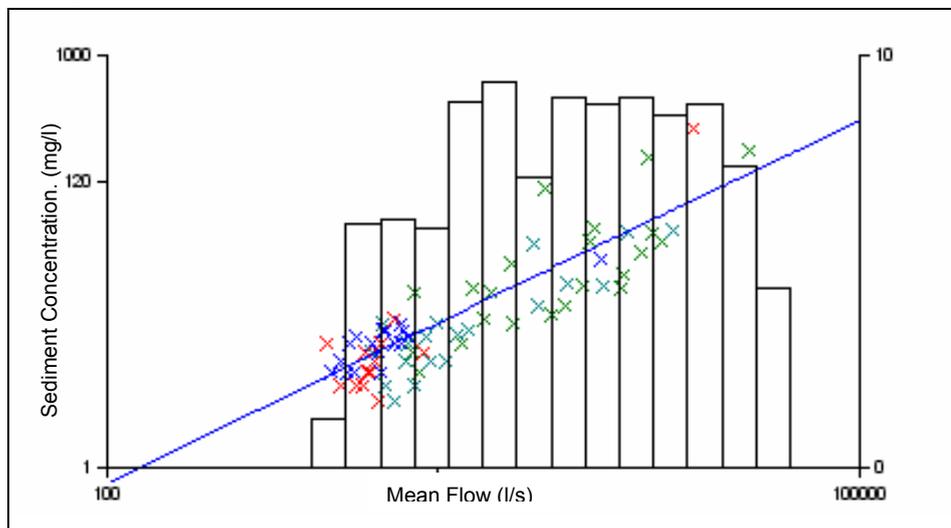
Data Information

| | Start Date | End Date |
|------------------------|------------|------------|
| Flow Time Series | 19/11/1980 | 31/12/2007 |
| Sediment Gaugings (73) | 12/08/1991 | 09/08/2004 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 1.4 | 10.9 | 93.8 | 10.3 |
| | Smearing | 1.4 | 11.0 | 93.8 | 10.3 |
| Min Variance | n/a | 1.4 | 10.8 | 93.9 | 8.5 |
| Load Weighted | QMLE | 1.4 | 10.5 | 93.9 | 10.2 |
| | Smearing | 1.4 | 11.0 | 93.9 | 10.2 |
| LOWESS | QMLE | 1.2 | 10.2 | 94.2 | 10.0 |
| | Smearing | 1.3 | 11.0 | 94.2 | 10.0 |
| | Parameter averages | 1.4 | 10.8 | 94.0 | 9.9 |
| Specific yield (kt/km²/yr) | 0.008 | | | | |

Example Plot



Plotted Yield Method: Minimum Variance

Comments

The results for average sediment yield at Dreadnought Culvert range from 1.2 to 1.4 kt/yr, with the error in the yield estimate ranging from 8.5 to 10.3%. The mean suspended sediment concentration ranges from 10.2 to 11.0 mg/l and the specific yield is 0.008 kt/km²/yr.

68.0% of the flow range has been gauged with an average of 94.0% of the sediment yield occurring within this gauged range of flow.

Site3: Mangapu River - SH3 Bridge U/S of Mangaokewa Confluence
ISCO Automatic Sampler Installed

Site Information

Location: SH3 Bridge Map Ref (NZMS260): S16:032-320
 Located no: 443.4 Upstream Catchment Area (sq km): 151
 Source: Mangapu

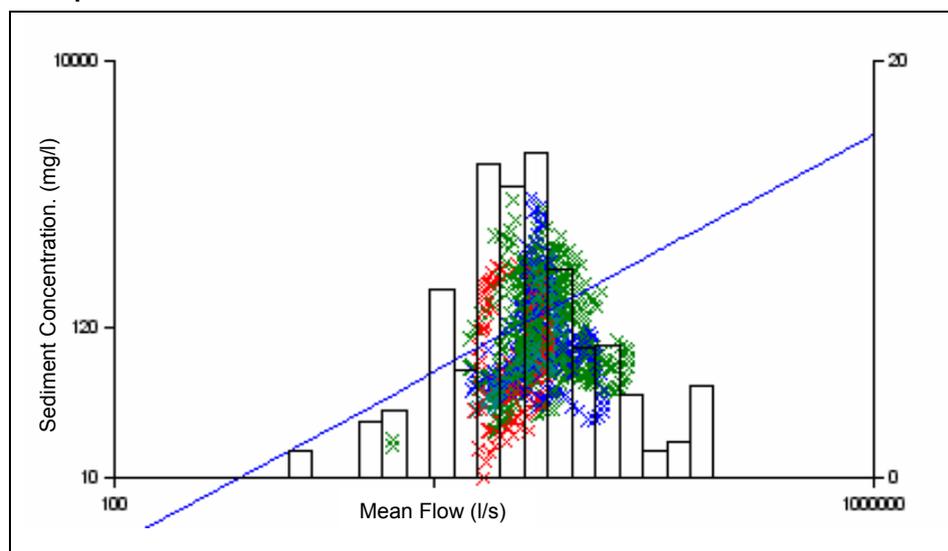
Data Information

| | Start Date | End Date |
|---|------------|------------|
| Flow Time Series | 17/10/2000 | 31/12/2007 |
| Sediment Gaugings (889 samples) | 12/12/2000 | 31/07/2007 |
| ISCO Period of Record (39 events sampled) | 12/12/2000 | 31/07/2007 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 17.6 | 87.0 | 86.5 | 7.1 |
| | Smearing | 18.0 | 88.6 | 86.5 | 7.1 |
| Min Variance | n/a | 17.6 | 86.3 | 86.6 | no data |
| Load Weighted | QMLE | 16.6 | 55.0 | 87.0 | 6.4 |
| | Smearing | 15.8 | 52.1 | 87.0 | 6.4 |
| LOWESS | QMLE | 11.7 | 39.5 | 94.8 | 5.4 |
| | Smearing | 12.8 | 43.1 | 94.8 | 5.4 |
| | Parameter averages | 15.7 | 64.5 | 89.0 | 6.3 |
| Specific yield (kt/km²/yr) | 0.104 | | | | |

Example Plot



Plotted Yield Method: Load Weighted - Smearing

Comments

The result for the average annual sediment yield at SH3 Bridge ranges from 11.7 to 18.0 kt/yr, with the error in the yield estimate ranging from 5.4 to 7.1%. The mean suspended sediment concentration ranges from 39.5 to 87.0 mg/l and the specific yield is 0.104 kt/km²/yr.

34.2% of the flow range has been gauged with an average of 89.0% of the sediment yield occurring within this gauged range of flow.

Site 4: Mangatutu River - Walker Road Bridge
ISCO Automatic Sampler Installed

Site Information

Location: Walker Road Map Ref (NZMS260): S15:203-422
 Located on: 476.7 Upstream Catchment Area (sq km): 122
 Source: Mangatutu

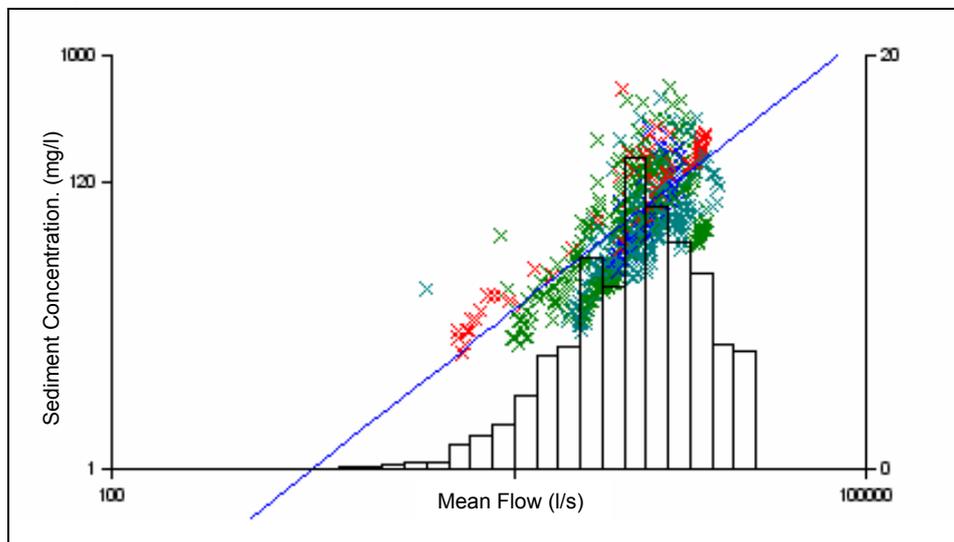
Data Information

| | Start Date | End Date |
|---|------------|------------|
| Flow Time Series | 8/06/2004 | 31/12/2007 |
| Sediment Gaugings (622 samples) | 22/06/2004 | 06/11/2007 |
| ISCO Period of Record (30 events sampled) | 22/06/2004 | 06/11/2007 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 5.2 | 17.7 | 88.8 | 4.1 |
| | Smearing | 5.3 | 18.2 | 88.8 | 4.1 |
| Min Variance | n/a | 5.2 | 17.6 | 88.8 | no data |
| Load Weighted | QMLE | 5.2 | 16.5 | 87.7 | 4.0 |
| | Smearing | 5.4 | 17.1 | 87.7 | 4.0 |
| LOWESS | QMLE | 4.8 | 15.9 | 88.1 | 4.1 |
| | Smearing | 5.3 | 17.7 | 88.1 | 4.1 |
| | Parameter averages | 5.2 | 17.2 | 88.3 | 4.1 |
| Specific yield (kt/km²/yr) | 0.043 | | | | |

Example Plot



Plotted Yield Method: Minimum Variance

Comments

The result for the average annual sediment yield at Walker Road ranges from 4.8 to 5.4 kt/yr, with the error in the yield estimate ranging from 4.0 to 4.1%. The mean suspended sediment concentration ranges from 15.9 to 18.2 mg/l and the specific yield is 0.043 kt/km²/yr.

66.0% of the flow range has been gauged with an average of 88.3% of the sediment yield occurring within this gauged range of flow.

Site 5: Matahuru River - Myjer property
ISCO Automatic Sampler Installed

Site Information

Location: Myjers Map Ref (NZMS260): S13:116-095
 Located no: 516.22 Upstream Catchment Area (sq km): 83
 Source: Matahuru

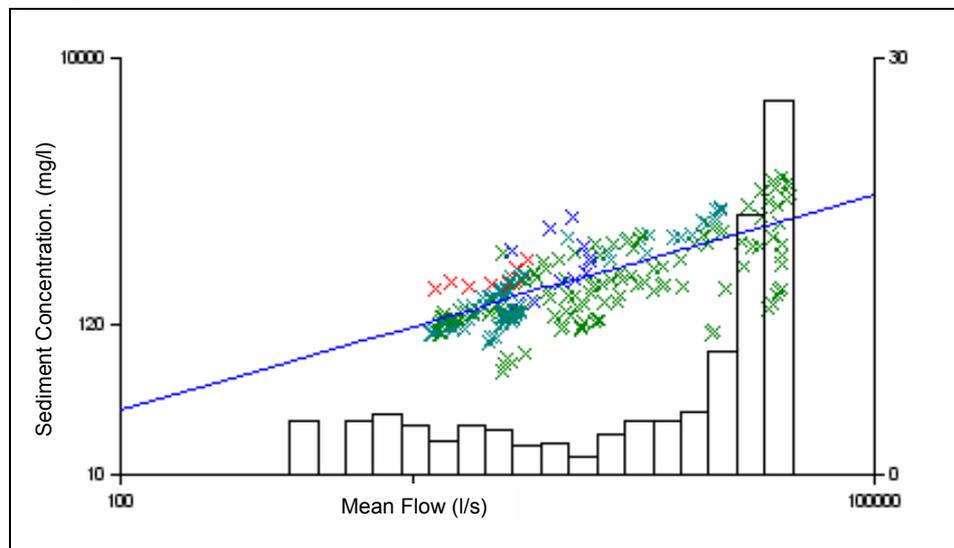
Data Information

| | Start Date | End Date |
|---|------------|------------|
| Flow Time Series | 17/07/2006 | 31/12/2007 |
| Sediment Gaugings (220 samples) | 19/07/2006 | 20/10/2007 |
| ISCO Period of Record (14 events sampled) | 19/07/2006 | 20/10/2007 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 12.2 | 103.7 | 16.9 | 5.9 |
| | Smearing | 12.1 | 102.8 | 16.9 | 5.9 |
| Min Variance | n/a | 12.2 | 103.4 | 16.9 | 3.3 |
| Load Weighted | QMLE | 12.3 | 102.5 | 16.7 | 5.9 |
| | Smearing | 12.2 | 101.5 | 16.7 | 5.9 |
| LOWESS | QMLE | 12.5 | 101.4 | 16.5 | 5.9 |
| | Smearing | 12.2 | 99.2 | 16.5 | 5.9 |
| | Parameter averages | 12.2 | 102.1 | 16.7 | 5.5 |
| Specific yield (kt/km²/yr) | 0.147 | | | | |

Example Plot



Plotted Yield Method: LOWESS - Smearing

Comments

The result for average annual sediment yield at Myjers ranges from 12.1 to 12.5kt/yr with the error in the yield estimate ranging from 3.3 to 5.9%. The mean suspended sediment concentration ranges from 99.2 to 103.7 mg/l and the specific yield is 0.147 kt/km²/yr.

96.8% of the flow range has been gauged with an average of 16.7% of the sediment yield occurring within this gauged range of flow.

Site 7: Opitonui River - D/S Awaroa Confluence
ISCO Automatic Sampler Installed

Site Information

| | | | |
|-------------|----------|----------------------------------|-------------|
| Location: | Opitonui | Map Ref (NZMS260): | T11:428-883 |
| Located no: | 660.1 | Upstream Catchment Area (sq km): | 29 |
| Source: | Opitonui | | |

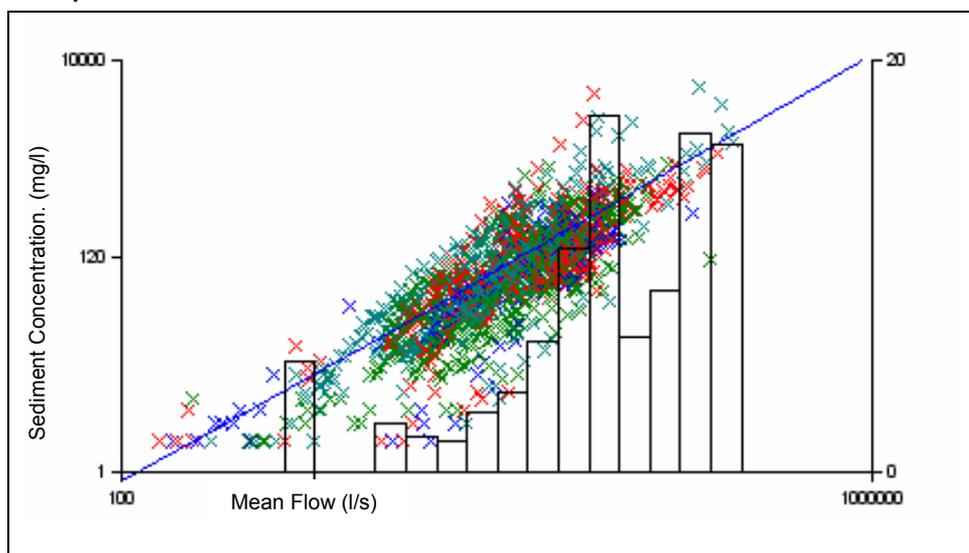
Data Information

| | Start Date | End Date |
|---|------------|------------|
| Flow Time Series | 17/06/1991 | 31/12/2007 |
| Sediment Gaugings (1262 samples) | 16/07/1991 | 02/10/2007 |
| ISCO Period of Record (52 events sampled) | 16/07/1999 | 02/10/2007 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 3.9 | 12.0 | 97.5 | 4.2 |
| | Smearing | 3.9 | 12.0 | 97.5 | 4.2 |
| Min Variance | n/a | 3.9 | 12.0 | 97.5 | 15.0 |
| Load Weighted | QMLE | 3.8 | 12.2 | 97.5 | 4.2 |
| | Smearing | 3.8 | 12.3 | 97.5 | 4.2 |
| LOWESS | QMLE | 3.9 | 12.0 | 97.5 | 4.2 |
| | Smearing | 4.0 | 12.1 | 97.5 | 4.2 |
| | Parameter averages | 3.9 | 12.1 | 97.5 | 5.7 |
| Specific yield (kt/km²/yr) | 0.134 | | | | |

Example Plot



Plotted Yield Method: LOWESS - QMLE

Comments

The result for average annual sediment yield at Opitonui ranges from 3.8 to 4.0kt/yr with the error in the yield estimate ranging from 4.2 to 15.0%. The mean suspended sediment concentration ranges from 12.0 to 12.3 mg/l and the specific yield is 0.134 kt/km²/yr.

89.6% of the flow range has been gauged with an average of 97.5% of the sediment yield occurring within this gauged range of flow.

Site 8: Oraka Stream - Pinedale

Site Information

| | | | |
|-------------|--------------|----------------------------------|-------------|
| Location: | Pinedale | Map Ref (NZMS260): | T15:563-446 |
| Located no: | 669.13 | Upstream Catchment Area (sq km): | 136 |
| Source: | Oraka Stream | | |

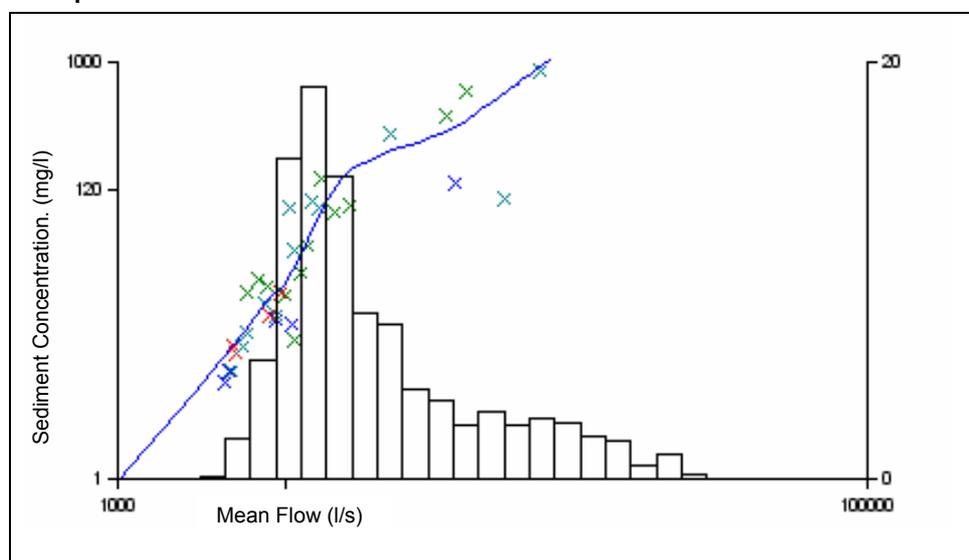
Data Information

| | Start Date | End Date |
|------------------------|------------|------------|
| Flow Time Series | 20/07/1979 | 13/12/2007 |
| Sediment Gaugings (34) | 22/04/1986 | 11/12/2003 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 5.1 | 37.2 | 82.0 | 24.7 |
| | Smearing | 5.0 | 36.4 | 82.0 | 24.7 |
| Min Variance | n/a | 5.0 | 36.6 | 83.2 | 18.8 |
| Load Weighted | QMLE | 6.9 | 43.8 | 74.6 | 28.5 |
| | Smearing | 6.0 | 38.0 | 74.6 | 28.5 |
| LOWESS | QMLE | 6.5 | 49.1 | 89.4 | 20.9 |
| | Smearing | 5.6 | 42.4 | 89.4 | 20.9 |
| | Parameter averages | 5.7 | 40.5 | 82.2 | 23.9 |
| Specific yield (kt/km²/yr) | 0.042 | | | | |

Example Plot



Plotted Yield Method: LOWESS - Smearing

Comments

The results for average sediment yield at Pinedale range from 5.0 to 6.9 kt/yr with the error in the yield estimate ranging from 18.8 to 28.5%. The mean suspended sediment concentration ranges from 36.4 to 49.1 mg/l and the specific yield is 0.042 kt/km²/yr.

32.5% of the flow range has been gauged with an average of 82.2% of the sediment yield occurring within this gauged range of flow.

Site 9: Piako River - Paeroa-Tahuna Road Bridge

Site Information

Location: Paeroa-Tahuna Map Ref (NZMS260): T13:318-068
 Located no: 749.15 Upstream Catchment Area (sq km): 491
 Source: Piako

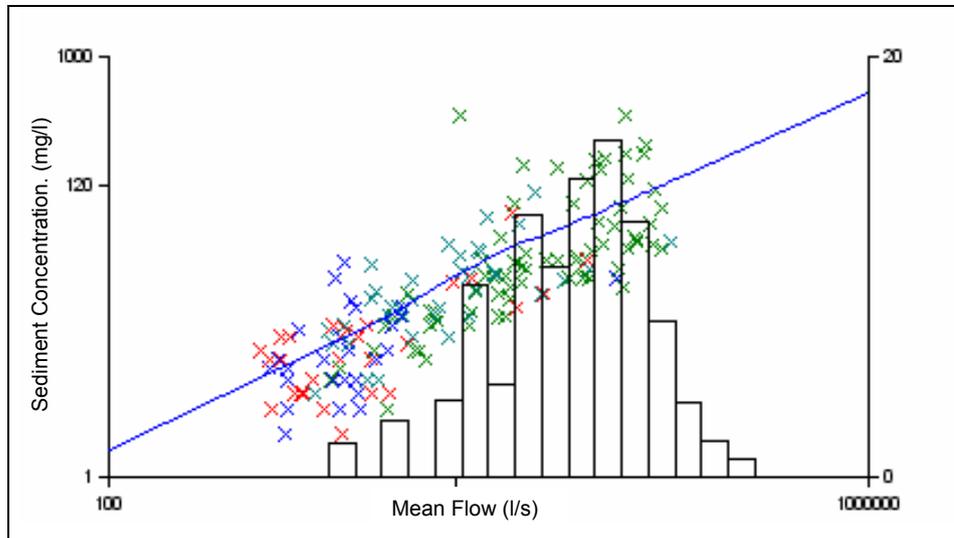
Data Information

| | Start Date | End Date |
|-------------------------|------------|------------|
| Flow Time Series | 3/07/1972 | 31/12/2007 |
| Sediment Gaugings (162) | 17/04/1986 | 22/06/2004 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 10.5 | 21.0 | 92.6 | 8.5 |
| | Smearing | 11.1 | 22.2 | 92.6 | 8.5 |
| Min Variance | n/a | 10.5 | 21.0 | 92.7 | 8.0 |
| Load Weighted | QMLE | 11.1 | 21.8 | 92.4 | 8.5 |
| | Smearing | 11.4 | 22.3 | 92.4 | 8.5 |
| LOWESS | QMLE | 10.4 | 21.1 | 93.3 | 8.4 |
| | Smearing | 11.1 | 22.5 | 93.3 | 8.4 |
| | Parameter averages | 10.9 | 21.7 | 92.8 | 8.4 |
| Specific yield (kt/km²/yr) | 0.022 | | | | |

Example Plot



Plotted Yield Method: LOWESS - Smearing

Comments

The results for average sediment yield at Paeroa-Tahuna range from 10.4 to 11.4 kt/yr with the error in the yield estimate ranging from 8.0 to 8.5%. The mean suspended sediment concentration ranges from 21.0 to 22.5 mg/l and the specific yield is 0.022 kt/km²/yr.

36.1% of the flow range has been gauged with an average of 92.8% of the sediment yield occurring within this gauged range of flow.

Site 10: Tapu River - Tapu-Coroglen Road

Site Information

Location: Tapu-Coroglen Map Ref (NZMS260): T11:332-658
 Located no: 954.5 Upstream Catchment Area (sq km): 26
 Source: Tapu

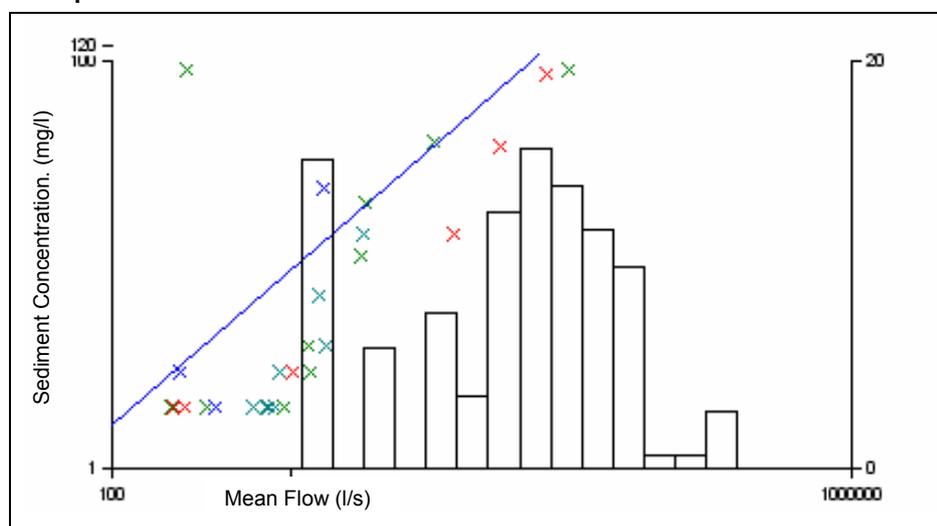
Data Information

| | Start Date | End Date |
|------------------------|------------|------------|
| Flow Time Series | 1/07/1991 | 31/12/2007 |
| Sediment Gaugings (28) | 15/07/1991 | 08/04/1999 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 1.1 | 10.7 | 75.6 | 43.7 |
| | Smearing | 1.8 | 17.5 | 75.6 | 43.7 |
| Min Variance | n/a | 1.0 | 10.4 | 77.3 | 38.2 |
| Load Weighted | QMLE | 0.7 | 8.5 | 82.0 | 39.0 |
| | Smearing | 1.2 | 15.1 | 82.0 | 39.0 |
| LOWESS | QMLE | 1.3 | 8.5 | 69.1 | 48.9 |
| | Smearing | 2.3 | 15.0 | 69.1 | 48.9 |
| | Parameter averages | 1.3 | 12.2 | 75.8 | 43.1 |
| Specific yield (kt/km²/yr) | 0.050 | | | | |

Example Plot



Plotted Yield Method: LOWESS - QMLE

Comments

The results for average sediment yield at Tapu-Coroglen range from 0.7 to 2.3 kt/yr with the error in the yield estimate ranging from 38.2 to 48.9%. The mean suspended sediment concentration ranges from 8.5 to 17.5 mg/l and the specific yield is 0.050 kt/km²/yr.

12.3% of the flow range has been gauged with an average of 75.8% of the sediment yield occurring within this gauged range of flow.

Site 11: Tauranga-Taupo River - Te Kono Slackline

Site Information

Location: Te Kono Slackline Map Ref (NZMS260): T19:636-473
 Located no: 971.4 Upstream Catchment Area (sq km): 197
 Source: Tauranga-Taupo

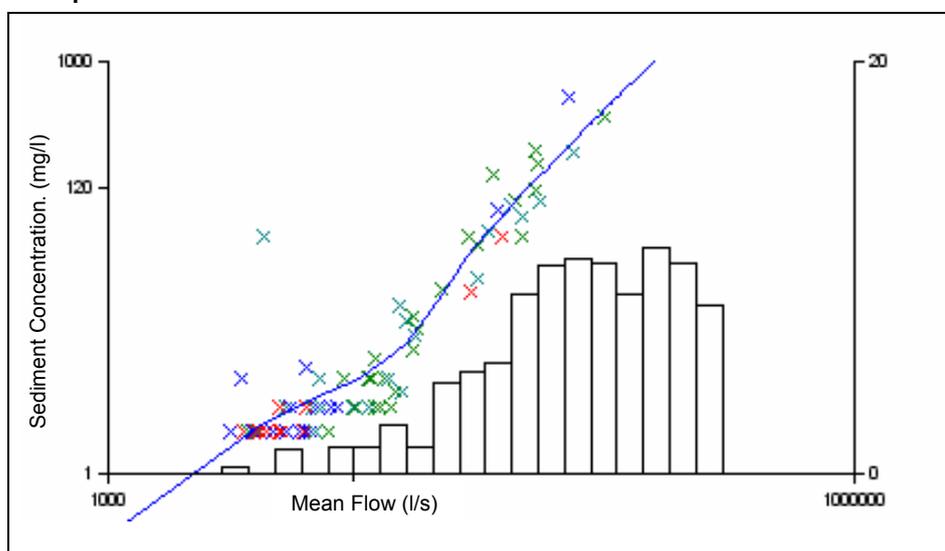
Data Information

| | Start Date | End Date |
|------------------------|------------|------------|
| Flow Time Series | 11/02/1976 | 31/12/2007 |
| Sediment Gaugings (77) | 7/08/1990 | 08/11/2006 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 11.7 | 10.5 | 65.2 | 19.0 |
| | Smearing | 14.2 | 12.7 | 65.2 | 19.0 |
| Min Variance | n/a | 11.5 | 10.4 | 65.7 | 17.1 |
| Load Weighted | QMLE | 12.4 | 9.6 | 60.5 | 20.1 |
| | Smearing | 19.2 | 14.8 | 60.5 | 20.1 |
| LOWESS | QMLE | 14.5 | 9.8 | 55.6 | 21.1 |
| | Smearing | 17.7 | 11.9 | 55.6 | 21.1 |
| | Parameter averages | 14.5 | 11.4 | 61.2 | 19.6 |
| Specific yield (kt/km²/yr) | 0.074 | | | | |

Example Plot



Plotted Yield Method: LOWESS - QMLE

Comments

The results for average sediment yield at Te Kono Slackline range from 11.7 to 19.2 kt/yr with the error in the yield estimate ranging from 19.0 to 21.1%. The mean suspended sediment concentration ranges from 9.6 to 14.8mg/l and the specific yield is 0.074 kt/km²/yr.

32.9% of the flow range has been gauged with an average of 61.2% of the sediment yield occurring within this gauged range of flow.

Site 12: Waihou River - Okauia

Site Information

Location: Okauia Map Ref (NZMS260): T14:602-756
 Located no: 1122.18 Upstream Catchment Area (sq km): 816
 Source: Waihou

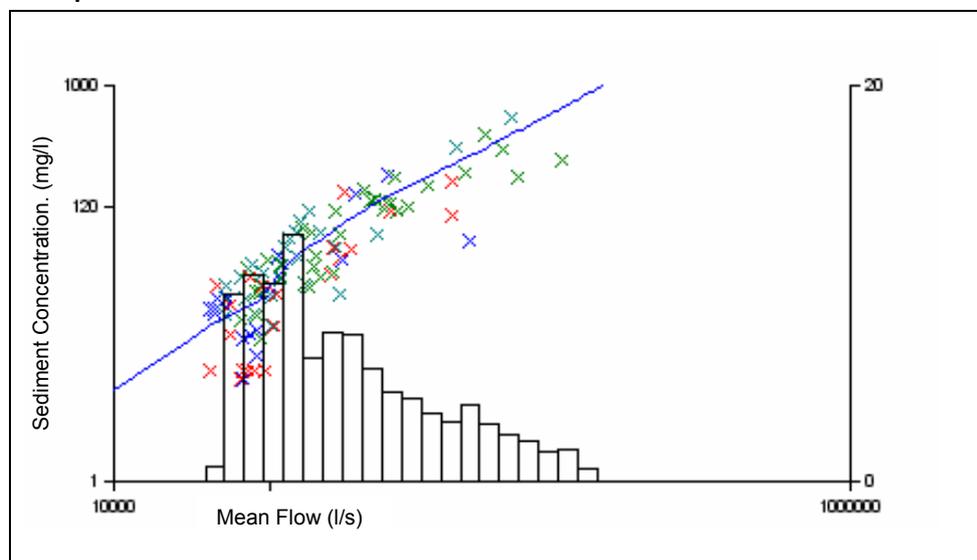
Data Information

| | Start Date | End Date |
|-------------------------|------------|------------|
| Flow Time Series | 23/03/1982 | 31/12/2007 |
| Sediment Gaugings (100) | 01/05/1986 | 20/07/2006 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 40.4 | 35.7 | 60.5 | 9.1 |
| | Smearing | 39.5 | 34.9 | 60.5 | 9.1 |
| Min Variance | n/a | 40.2 | 35.6 | 60.6 | 6.6 |
| Load Weighted | QMLE | 43.7 | 34.9 | 54.5 | 9.9 |
| | Smearing | 43.5 | 34.8 | 54.5 | 9.9 |
| LOWESS | QMLE | 41.2 | 35.4 | 59.4 | 8.9 |
| | Smearing | 39.9 | 34.3 | 59.4 | 8.9 |
| | Parameter averages | 41.2 | 35.1 | 58.5 | 8.9 |
| Specific yield (kt/km²/yr) | 0.050 | | | | |

Example Plot



Plotted Yield Method: LOWESS - QMLE

Comments

The results for average sediment yield at Okauia range from 39.5 to 43.7 kt/yr with the error in the yield estimate ranging from 6.6 to 9.9%. The mean suspended sediment concentration ranges from 34.3 to 35.6 mg/l and the specific yield is 0.050 kt/km²/yr.

77.8% of the flow range has been gauged with an average of 58.5% of the sediment yield occurring within this gauged range of flow.

Site 13: Waihou River - Te Aroha

Site Information

| | | | |
|-------------|----------|----------------------------------|-------------|
| Location: | Te Aroha | Map Ref (NZMS260): | T13:494-026 |
| Located no: | 1122.34 | Upstream Catchment Area (sq km): | 1109 |
| Source: | Waihou | | |

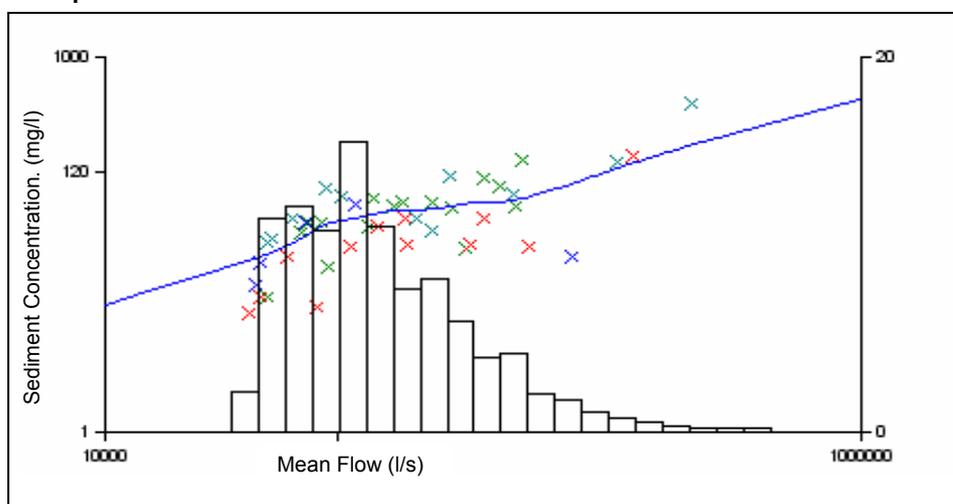
Data Information

| | Start Date | End Date |
|------------------------|------------|------------|
| Flow Time Series | 11/01/1965 | 31/12/2007 |
| Sediment Gaugings (44) | 18/04/1986 | 02/08/2007 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 61.4 | 39.8 | 99.3 | 11.6 |
| | Smearing | 59.9 | 38.8 | 99.3 | 11.6 |
| Min Variance | n/a | 61.0 | 39.5 | 99.3 | 9.3 |
| Load Weighted | QMLE | 65.2 | 43.9 | 99.5 | 11.5 |
| | Smearing | 61.3 | 41.2 | 99.5 | 11.5 |
| LOWESS | QMLE | 67.9 | 45.4 | 99.3 | 11.5 |
| | Smearing | 61.1 | 40.9 | 99.3 | 11.5 |
| | Parameter averages | 62.5 | 41.4 | 99.4 | 11.2 |
| Specific yield (kt/km²/yr) | 0.056 | | | | |

Example Plot



Plotted Yield Method: LOWESS - Smearing

Comments

The results for average sediment yield at Te Aroha range from 60.0 to 65.3 kt/yr with the error in the yield estimate ranging from 9.5 to 12.0%. The mean suspended sediment concentration ranges from 38.9 to 44.0 mg/l and the specific yield is 0.056 kt/km²/yr.

59.6% of the flow range has been gauged with an average of 99.4% of the sediment yield occurring within this gauged range of flow.

Site14: Waikato River - Hamilton Traffic Bridge

Site Information

Location: Hamilton Traffic Map Ref (NZMS260): S14:118-764
 Located no: 1131.64 Upstream Catchment Area (sq km): 8230
 Source: Waikato

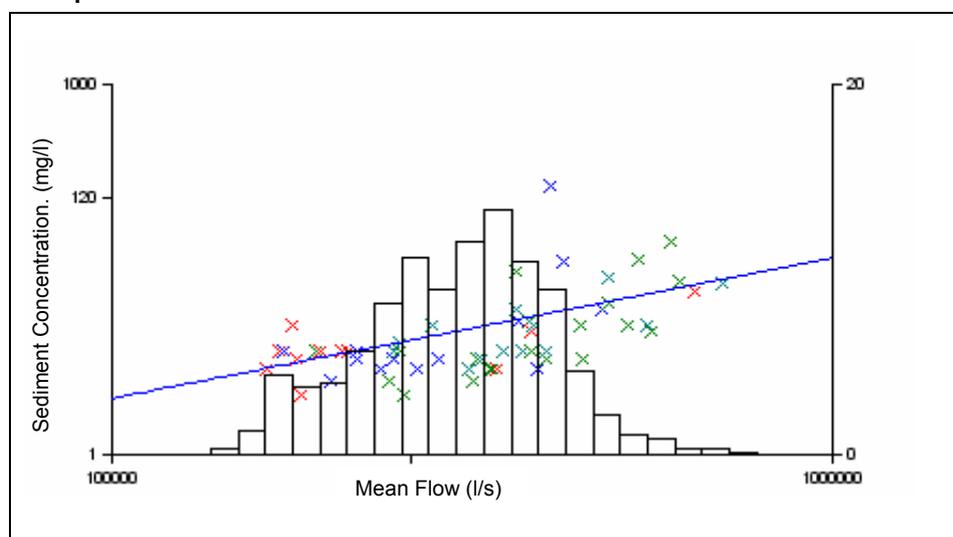
Data Information

| | Start Date | End Date |
|------------------------|------------|------------|
| Flow Time Series | 22/12/1975 | 31/12/2007 |
| Sediment Gaugings (57) | 20/08/1991 | 01/03/2004 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 77.4 | 8.5 | 98.1 | 10.5 |
| | Smearing | 83.2 | 9.2 | 98.1 | 10.5 |
| Min Variance | n/a | 77.0 | 8.5 | 98.2 | 8.9 |
| Load Weighted | QMLE | 71.7 | 8.0 | 98.0 | 10.6 |
| | Smearing | 84.9 | 9.5 | 98.0 | 10.6 |
| LOWESS | QMLE | 65.5 | 7.5 | 97.3 | 10.9 |
| | Smearing | 80.7 | 9.3 | 97.3 | 10.9 |
| | Parameter averages | 77.2 | 8.6 | 97.9 | 10.4 |
| Specific yield (kt/km²/yr) | 0.009 | | | | |

Example Plot



Plotted Yield Method: OLS - QMLE

Comments

The results for average sediment yield at Hamilton Traffic Bridge range from 65.5 to 84.9 kt/yr with the error in the yield estimate ranging from 8.9 to 10.9%. The mean suspended sediment concentration ranges from 7.5 to 9.5 mg/l and the specific yield is 0.009 kt/km²/yr.

83.6% of the flow range has been gauged with an average of 97.9% of the sediment yield occurring within this gauged range of flow.

Site 15: Waikato River - Rangiriri Bridge

Site Information

Location: Rangiriri Bridge Map Ref (NZMS260): S13:987-167
 Located no: 1131.117 Upstream Catchment Area (sq km): 12421
 Source: Waikato

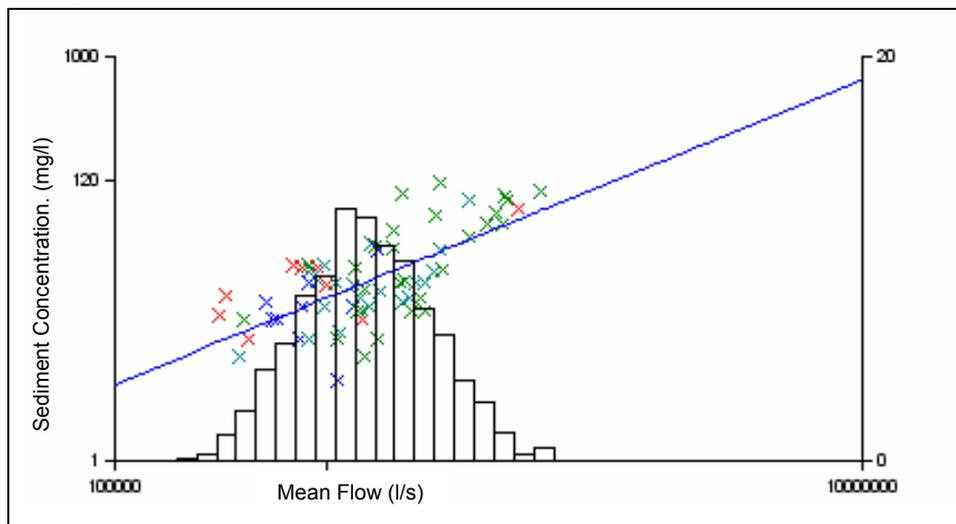
Data Information

| | Start Date | End Date |
|------------------------|------------|------------|
| Flow Time Series | 1/04/1965 | 31/12/2007 |
| Sediment Gaugings (66) | 16/09/1991 | 13/08/2007 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 264.5 | 19.3 | 99.0 | 9.6 |
| | Smearing | 261.2 | 19.0 | 99.0 | 9.6 |
| Min Variance | n/a | 263.3 | 19.2 | 99.0 | 7.7 |
| Load Weighted | QMLE | 243.8 | 18.3 | 98.9 | 9.6 |
| | Smearing | 265.0 | 19.9 | 98.9 | 9.6 |
| LOWESS | QMLE | 254.6 | 19.2 | 98.6 | 9.9 |
| | Smearing | 254.9 | 19.3 | 98.6 | 9.9 |
| | Parameter averages | 258.2 | 19.2 | 98.9 | 9.4 |
| Specific yield (kt/km²/yr) | 0.021 | | | | |

Example Plot



Plotted Yield Method: LOWESS - Smearing

Comments

The results for average sediment yield at Rangiriri Bridge range from 245.4 to 266.6 kt/yr with the error in the yield estimate ranging from 7.7 to 10.0%. The mean suspended sediment concentration ranges from 18.3 to 19.9 mg/l and the specific yield is 0.021 kt/km²/yr.

88.2% of the flow range has been gauged with an average of 98.9% of the sediment yield occurring within this gauged range of flow.

Site 16: Waingaro River - Ruakiwi Road off SH22
ISCO Automatic Sampler Installed

Site Information

Location: Ruakiwi Road Map Ref (NZMS260): R14:837-837
 Located no: 1167.4 Upstream Catchment Area (sq km): 118
 Source: Waingaro

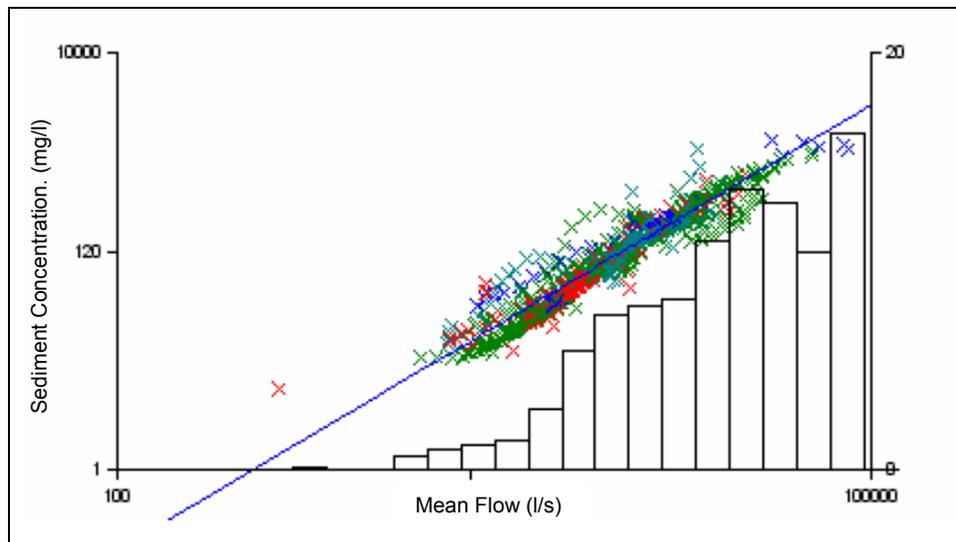
Data Information

| | Start Date | End Date |
|---|------------|------------|
| Flow Time Series | 30/11/2001 | 31/12/2007 |
| Sediment Gaugings (673 samples) | 16/05/2002 | 02/05/2007 |
| ISCO Period of Record (31 events sampled) | 10/06/2002 | 13/03/2007 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 11.4 | 25.0 | 83.9 | 2.7 |
| | Smearing | 11.4 | 25.2 | 83.9 | 2.7 |
| Min Variance | n/a | 11.4 | 25.0 | 83.9 | 0.6 |
| Load Weighted | QMLE | 11.8 | 25.0 | 83.2 | 2.7 |
| | Smearing | 11.9 | 25.2 | 83.2 | 2.7 |
| LOWESS | QMLE | 11.7 | 23.3 | 83.0 | 2.7 |
| | Smearing | 12.7 | 25.2 | 83.0 | 2.7 |
| | Parameter averages | 11.8 | 24.8 | 83.4 | 2.4 |
| Specific yield (kt/km²/yr) | 0.100 | | | | |

Example Plot



Plotted Yield Method: Load Weighted - QMLE

Comments

The results for the average annual sediment yield at Ruakiwi Road range from 11.4 to 12.7 kt/yr with the error in the yield estimate ranging from 0.6 to 2.7%. The mean suspended sediment concentration ranges from 23.3 to 25.2 mg/l and the specific yield is 0.100 kt/km²/yr.

71.7% of the flow range has been gauged with an average of 83.4% of the sediment yield occurring within this gauged range of flow.

Site 17: Waipa River - Otewa
ISCO Automatic Sampler Installed

Site Information

Location: Otewa Map Ref (NZMS260): S16:157-235
 Located no: 1191.7 Upstream Catchment Area (sq km): 319
 Source: Waipa

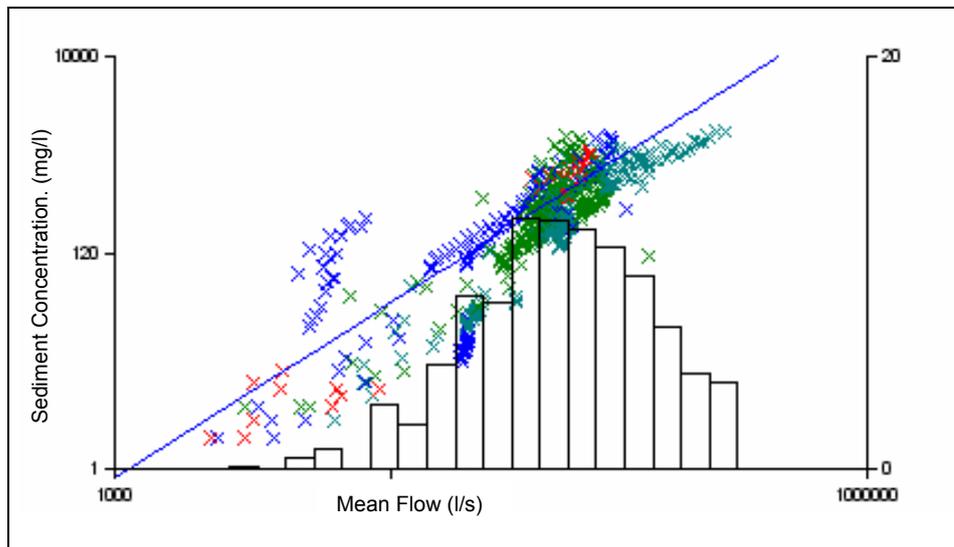
Data Information

| | Start Date | End Date |
|---|------------|------------|
| Flow Time Series | 22/05/1985 | 31/12/2007 |
| Sediment Gaugings (587 samples) | 6/08/1990 | 31/17/2007 |
| ISCO Period of Record (21 events sampled) | 1/10/2000 | 31/07/2007 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 71.4 | 54.9 | 94.3 | 4.7 |
| | Smearing | 74.1 | 57.0 | 94.3 | 4.7 |
| Min Variance | n/a | 71.3 | 54.8 | 94.3 | 8.9 |
| Load Weighted | QMLE | 75.2 | 45.7 | 91.1 | 4.8 |
| | Smearing | 95.9 | 58.3 | 91.1 | 4.8 |
| LOWESS | QMLE | 60.7 | 41.6 | 94.7 | 4.6 |
| | Smearing | 71.3 | 48.9 | 94.7 | 4.6 |
| | Parameter averages | 74.3 | 51.6 | 93.5 | 5.3 |
| Specific yield (kt/km²/yr) | 0.233 | | | | |

Example Plot



Plotted Yield Method: OLS - Smearing

Comments

The results for the average annual sediment yield at Otewa ranges from 60.7 to 95.9 kt/yr with the error in the yield estimate ranging from 4.6 to 8.9%. The mean suspended sediment concentration ranges from 45.7 to 57.0 mg/l and the specific yield is 0.233 kt/km²/yr.

68.8% of the flow range has been gauged with an average of 93.5% of the sediment yield occurring within this gauged range of flow.

Site 18: Waipa River - Otorohanga Bridge SH31

Site Information

Location: Otorohanga Map Ref (NZMS260): S16:029-329
 Located no: 1191.13 Upstream Catchment Area (sq km): 919
 Source: Waipa

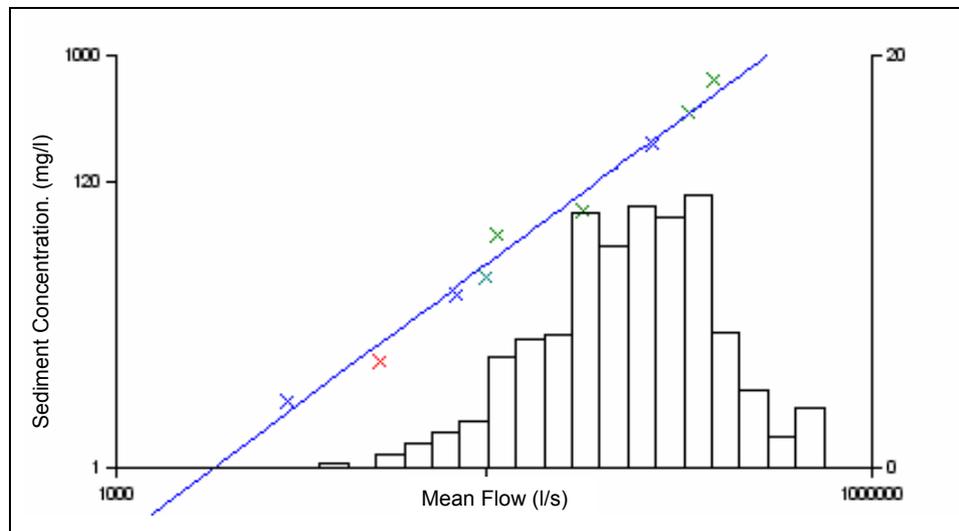
Data Information

| | Start Date | End Date |
|-----------------------|------------|------------|
| Flow Time Series | 22/05/1981 | 31/12/2007 |
| Sediment Gaugings (9) | 8/08/1990 | 07/08/1991 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 92.9 | 37.0 | 84.9 | 12.9 |
| | Smearing | 92.2 | 36.8 | 84.9 | 12.9 |
| Min Variance | n/a | 92.2 | 36.8 | 85.0 | 11.3 |
| Load Weighted | QMLE | 87.5 | 35.4 | 85.2 | 12.8 |
| | Smearing | 90.5 | 36.6 | 85.2 | 12.8 |
| LOWESS | QMLE | 87.0 | 33.6 | 83.3 | 13.1 |
| | Smearing | 90.9 | 35.1 | 83.3 | 13.1 |
| | Parameter averages | 90.5 | 35.9 | 84.5 | 12.7 |
| Specific yield (kt/km²/yr) | 0.098 | | | | |

Example Plot



Plotted Yield Method: Load Weighted - Smearing

Comments

The results for average sediment yield at Otorohanga range from 87.0 to 92.9 kt/yr with the error in the yield estimate ranging from 11.3 to 13.1%. The mean suspended sediment concentration ranges from 33.6 to 37.0 mg/l and the specific yield is 0.098 kt/km²/yr.

35.8% of the flow range has been gauged with an average of 84.5% of the sediment yield occurring within this gauged range of flow.

Site 19: Waipa River - Whatawhata Bridge SH23

Site Information

Location: Whatawhata Map Ref (NZMS260): S14:996-760
 Located no: 1191.11 Upstream Catchment Area (sq km): 2830
 Source: Waipa

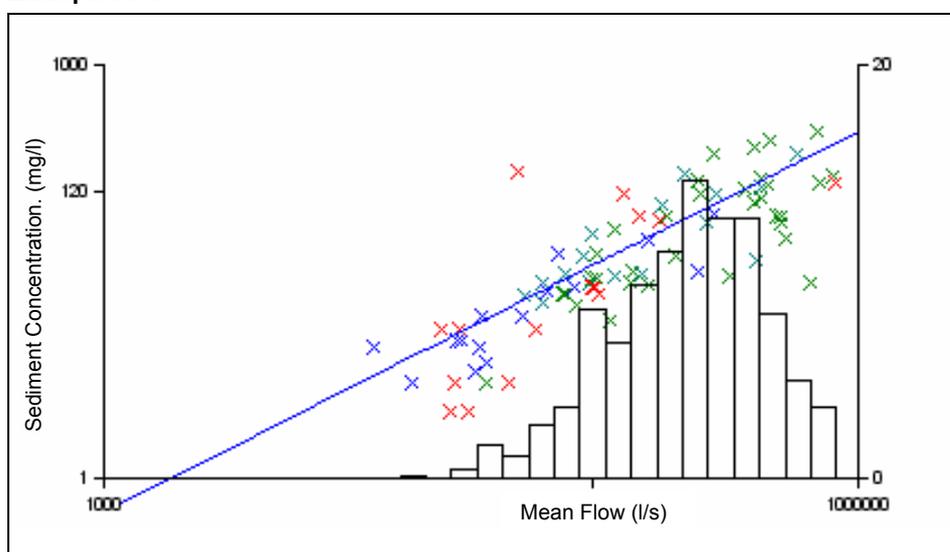
Data Information

| | Start Date | End Date |
|------------------------|------------|------------|
| Flow Time Series | 7/04/1972 | 31/12/2007 |
| Sediment Gaugings (81) | 22/05/1990 | 16/08/2007 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 157.9 | 33.3 | 99.7 | 9.4 |
| | Smearing | 161.0 | 34.0 | 99.7 | 9.4 |
| Min Variance | n/a | 157.2 | 33.2 | 99.7 | 8.5 |
| Load Weighted | QMLE | 174.1 | 35.9 | 99.7 | 9.5 |
| | Smearing | 164.6 | 33.9 | 99.7 | 9.5 |
| LOWESS | QMLE | 174.2 | 35.4 | 99.7 | 9.4 |
| | Smearing | 175.1 | 35.6 | 99.7 | 9.4 |
| | Parameter averages | 166.3 | 34.5 | 99.7 | 9.3 |
| Specific yield (kt/km²/yr) | 0.059 | | | | |

Example Plot



Plotted Yield Method: Load Weighted - Smearing

Comments

The results for average sediment yield at Whatawhata range from 157.2 to 175.1 kt/yr with the error in the yield estimate ranging from 8.5 to 9.5%. The mean suspended sediment concentration ranges from 33.3 to 35.9 mg/l and the specific yield is 0.059 kt/km²/yr.

98.4% of the flow range has been gauged with an average of 99.7% of the sediment yield occurring within this gauged range of flow.

Site 20: Waitoa River - Mellon Road Recorder

Site Information

Location: Mellon Road Map Ref (NZMS260): T13:426-027
 Located no: 1249.18 Upstream Catchment Area (sq km): 420
 Source: Waitoa

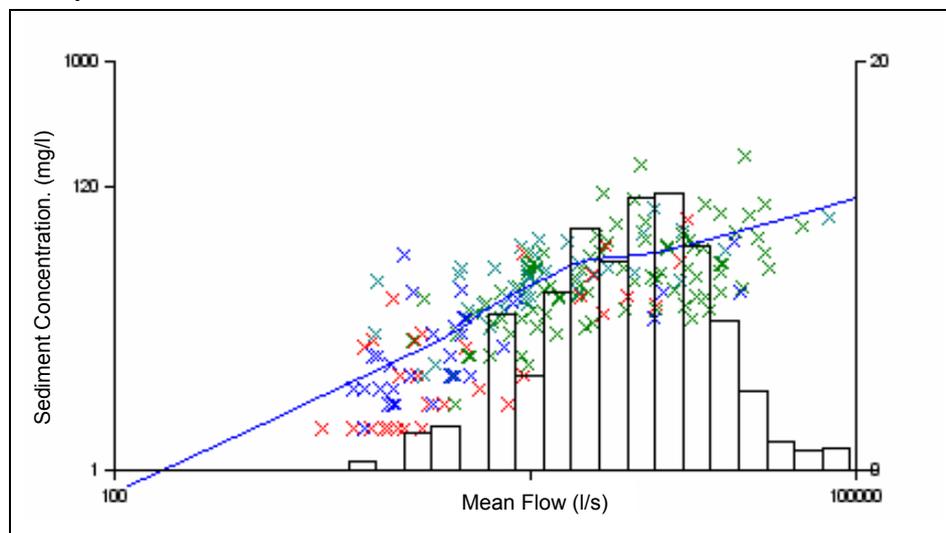
Data Information

| | Start Date | End Date |
|-------------------------|------------|------------|
| Flow Time Series | 2/05/1986 | 31/12/2007 |
| Sediment Gaugings (188) | 14/05/1986 | 08/08/2007 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 4.6 | 17.0 | 99.0 | 7.2 |
| | Smearing | 4.6 | 17.0 | 99.0 | 7.2 |
| Min Variance | n/a | 4.6 | 17.0 | 99.1 | 5.6 |
| Load Weighted | QMLE | 5.1 | 18.6 | 99.0 | 7.2 |
| | Smearing | 4.7 | 17.0 | 99.0 | 7.2 |
| LOWESS | QMLE | 4.8 | 18.3 | 99.3 | 6.9 |
| | Smearing | 4.7 | 17.9 | 99.3 | 6.9 |
| | Parameter averages | 4.7 | 17.5 | 99.1 | 6.9 |
| Specific yield (kt/km²/yr) | 0.011 | | | | |

Example Plot



Plotted Yield Method: LOWESS - Smearing

Comments

The result for average sediment yield at Mellon Road ranges from 4.6 to 5.1 kt/yr with the error in the yield estimate ranging from 5.6 to 7.2%. The mean suspended sediment concentration ranges from 17.0 to 18.6 mg/l and the specific yield is 0.011 kt/km²/yr.

82.1% of the flow range has been gauged with an average of 99.1% of the sediment yield occurring within this gauged range of flow.

Site 21: Waitomo Stream - Aranui Caves Bridge
(ISCO automatic sampler previously installed)

Site Information

| | | | |
|-------------|--------------|----------------------------------|-------------|
| Location: | Aranui Caves | Map Ref (NZMS260): | S16:921-244 |
| Located no: | 1253.3 | Upstream Catchment Area (sq km): | 31 |
| Source: | Waitomo | | |

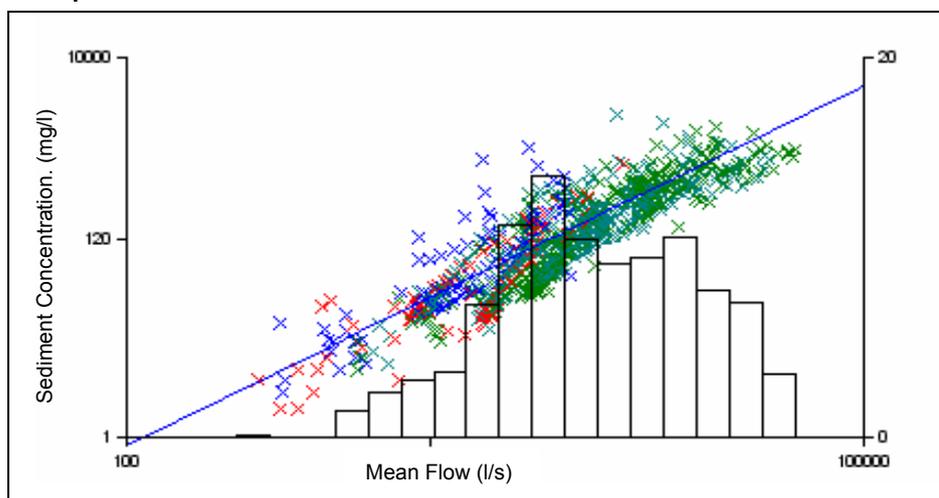
Data Information

| | Start Date | End Date |
|---|-------------------|-----------------|
| Flow Time Series | 7/10/1986 | 31/12/2007 |
| Sediment Gaugings (773) | 7/08/1990 | 20/07/2006 |
| ISCO Period of Record (27 events sampled) | 23/09/1997 | 03/10/2000 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 5.4 | 33.9 | 100.0 | 3.2 |
| | Smearing | 5.6 | 35.1 | 100.0 | 3.2 |
| Min Variance | n/a | 5.4 | 33.9 | 100.0 | 10.6 |
| Load Weighted | QMLE | 5.4 | 33.0 | 100.0 | 3.2 |
| | Smearing | 5.6 | 34.6 | 100.0 | 3.2 |
| LOWESS | QMLE | 5.1 | 31.3 | 100.0 | 3.2 |
| | Smearing | 5.6 | 34.4 | 100.0 | 3.2 |
| | Parameter averages | 5.4 | 33.7 | 100.0 | 4.3 |
| Specific yield (kt/km²/yr) | 0.174 | | | | |

Example Plot



Plotted Yield Method: OLS - QMLE

Comments

The result for the average annual sediment yield at Aranui Caves ranges between 5.1 and 5.6 kt/yr with the error in the yield estimate ranging from 3.2 to 10.6%. The mean suspended sediment concentration ranges from 31.3 to 35.1 mg/l and the specific yield is 0.193 kt/km²/yr.

99.7% of the flow range has been gauged with an average of 100% of the sediment yield occurring within this gauged range of flow.

Site 22: Whakapipi Stream - SH22 Bridge

Site Information

Location: SH22 Bridge Map Ref (NZMS260): R12:812-365
 Located no: 1282.8 Upstream Catchment Area (sq km): 42
 Source: Whakapipi

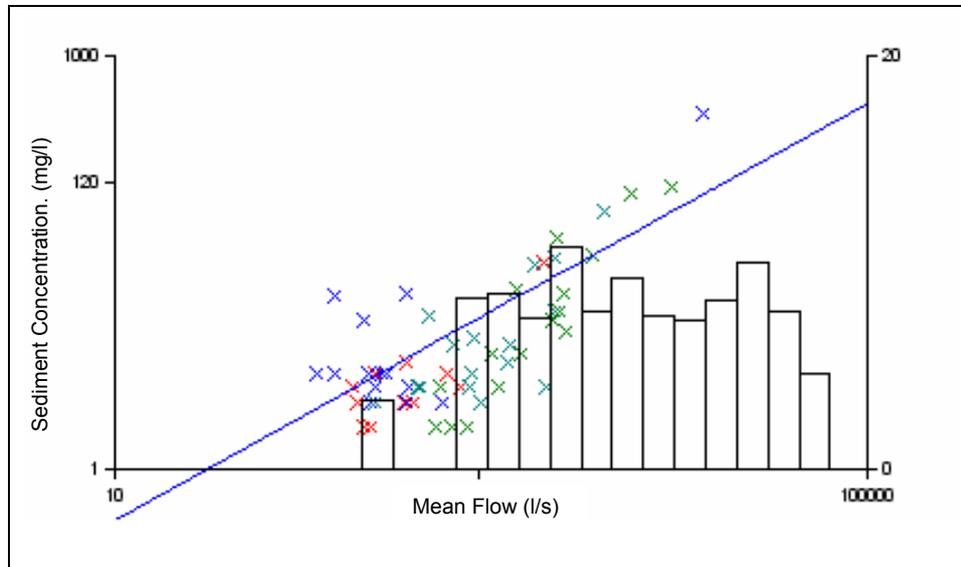
Data Information

| | Start Date | End Date |
|------------------------|------------|------------|
| Flow Time Series | 5/03/1984 | 31/12/2007 |
| Sediment Gaugings (58) | 9/01/1995 | 01/11/1999 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 0.9 | 11.4 | 68.9 | 26.6 |
| | Smearing | 0.9 | 11.5 | 68.9 | 26.6 |
| Min Variance | n/a | 0.8 | 11.2 | 69.9 | 23.5 |
| Load Weighted | QMLE | 0.5 | 9.0 | 76.6 | 24.0 |
| | Smearing | 0.6 | 11.1 | 76.6 | 24.0 |
| LOWESS | QMLE | 1.4 | 10.8 | 47.9 | 33.1 |
| | Smearing | 1.3 | 10.4 | 47.9 | 33.1 |
| | Parameter averages | 0.9 | 10.8 | 65.2 | 27.3 |
| Specific yield (kt/km²/yr) | 0.021 | | | | |

Example Plot



Plotted Yield Method: OLS – Smearing

Comments

The results for average sediment yield at SH22 Bridge range from 0.5 to 1.4kt/yr with the error in the yield estimate ranging from 23.5 to 33.1%. The mean suspended sediment concentration ranges from 9.0 to 11.5mg/l and the specific yield is 0.021 kt/km²/yr.

20.9% of the flow range has been gauged with an average of 65.2% of the sediment yield occurring within this gauged range of flow.

Site 23: Wharekawa River - Adams Farm Bridge
(ISCO automatic sampler previously installed)

Site Information

Location: Adams Farm Map Ref (NZMS260): T12:623-468
 Located no: 1312.1 Upstream Catchment Area (sq km): 47
 Source: Wharekawa

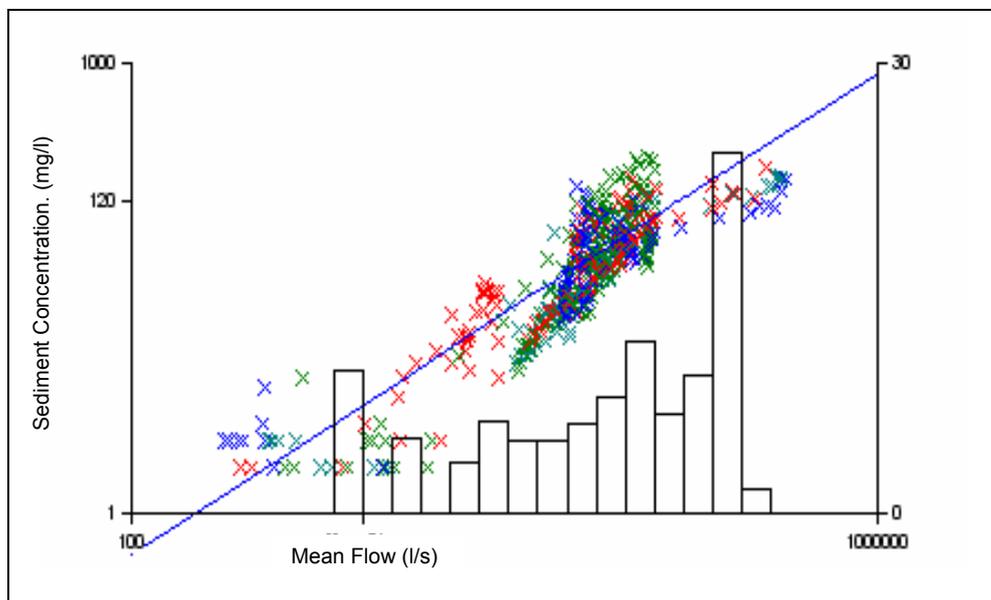
Data Information

| | Start Date | End Date |
|---|------------|------------|
| Flow Time Series | 10/06/1991 | 31/12/2007 |
| Sediment Gaugings (478) | 25/09/1991 | 27/02/2003 |
| ISCO Period of Record (19 events sampled) | 20/04/2000 | 27/02/2003 |

Sediment Information

| Yield method | Bias correction method | Average yield (kt/yr) | Mean concentration (mg/l) | % of yield in gauged range of flow | % error in yield estimate |
|--|---------------------------|-----------------------|---------------------------|------------------------------------|---------------------------|
| OLS | QMLE | 1.6 | 5.9 | 87.4 | 3.7 |
| | Smearing | 1.6 | 5.9 | 87.4 | 3.7 |
| Min Variance | n/a | 1.6 | 5.9 | 87.4 | 3.2 |
| Load Weighted | QMLE | 1.6 | 5.7 | 87.5 | 3.7 |
| | Smearing | 1.6 | 6.0 | 87.5 | 3.7 |
| LOWESS | QMLE | 1.4 | 4.9 | 88.7 | 3.6 |
| | Smearing | 1.5 | 5.3 | 88.7 | 3.6 |
| | Parameter averages | 1.6 | 5.7 | 87.8 | 3.6 |
| Specific yield (kt/km²/yr) | 0.034 | | | | |

Example Plot



Plotted Yield Method: Minimum Variance

Comments

The results for the average annual sediment yield at Adams Farm range from 1.4 to 1.6 kt/yr with the error in the yield estimate ranging from 3.2 to 3.7%. The mean suspended sediment concentration ranges from 4.9 to 6.0mg/l the specific yield is 0.034 kt/km²/yr.

57.4% of the flow range has been gauged with an average of 87.8% of the sediment yield occurring within this gauged range of flow.