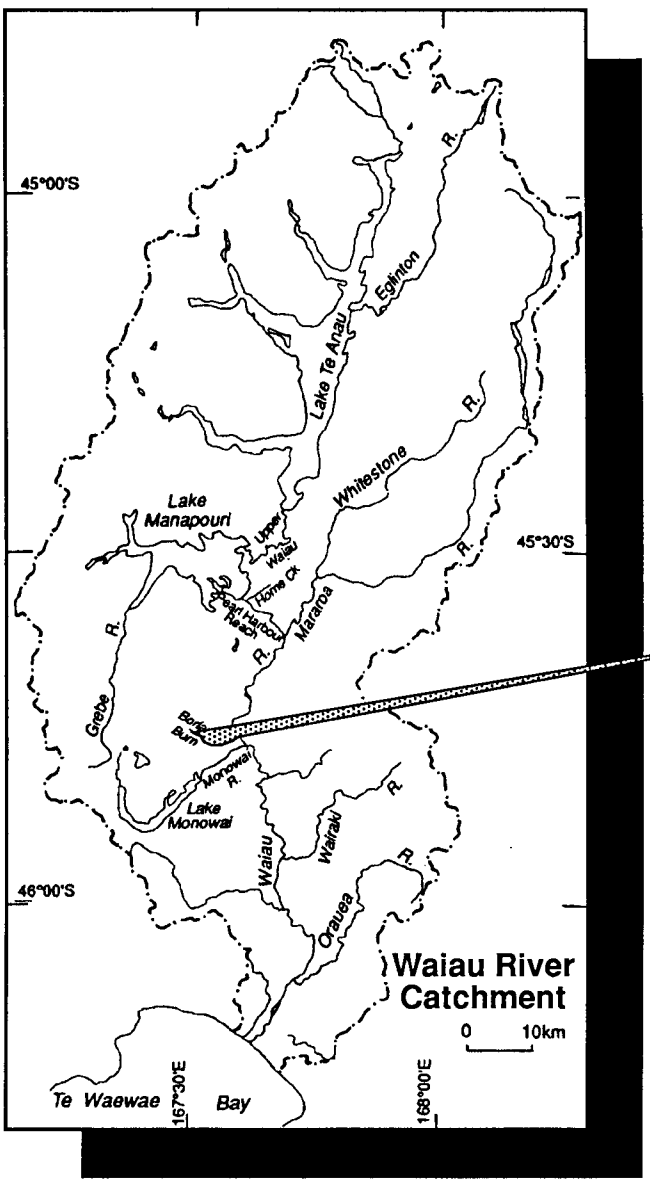
BORLAND BURN
Reach Analysis

Gary J. BRIERLEY
April, 1993



Borland Burn

Tables of contents **Page**

Valley setting 2

Pig Creek subreach 5

Borland Burn Confluence Subreach 12

REACH NAME : BORLAND BURN

Geographic description of reach : Borland Burn is a right bank tributary of Waiau River. It drains from Hunter Mountains in Fiordland National Park, and joins Waiau River 2 km upstream from Monowai Powerhouse. The reach studied extends from just upstream of Pig Creek confluence (near Borland Lodge) down to Waiau River confluence. Two subreaches are discerned. Pig Creek subreach is characterized by two and occasionally three channels divided around large, stable bars. Borland Burn confluence subreach is a bedrock-constrained reach, through which coarse clasts are effectively flushed. A shallow, bedrock-based bar has accumulated at Waiau confluence.

Analysts : GB, AB Date of Analysis : 25.01.93

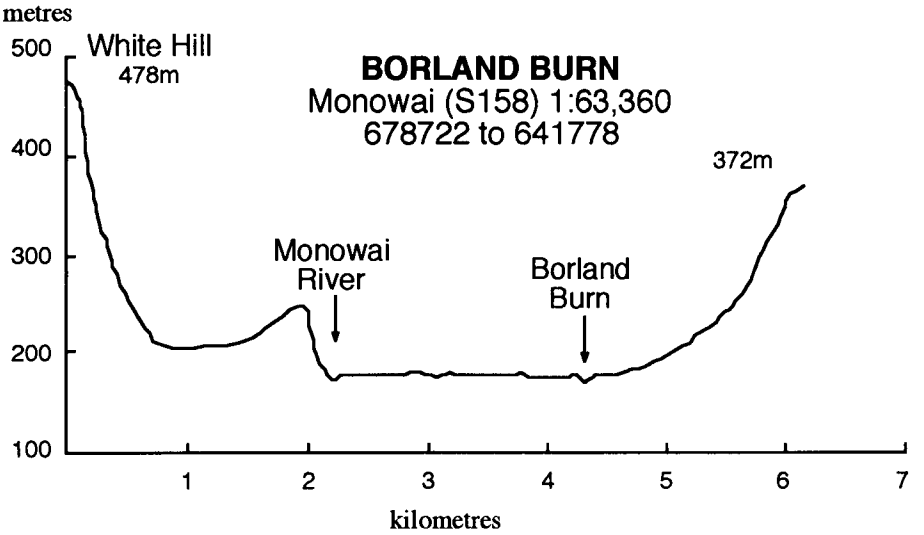
Grid co-ordinates of reach : Monowai (1:63,360), NZMS 1 S158, GR 622768 to 685772

Pig Creek subreach	GR 622768 to 645659
Borland Burn Confluence subreach	GR 645659 to 685772

Air Photos used :

VALLEY CHARACTERISTICS

Valley cross section



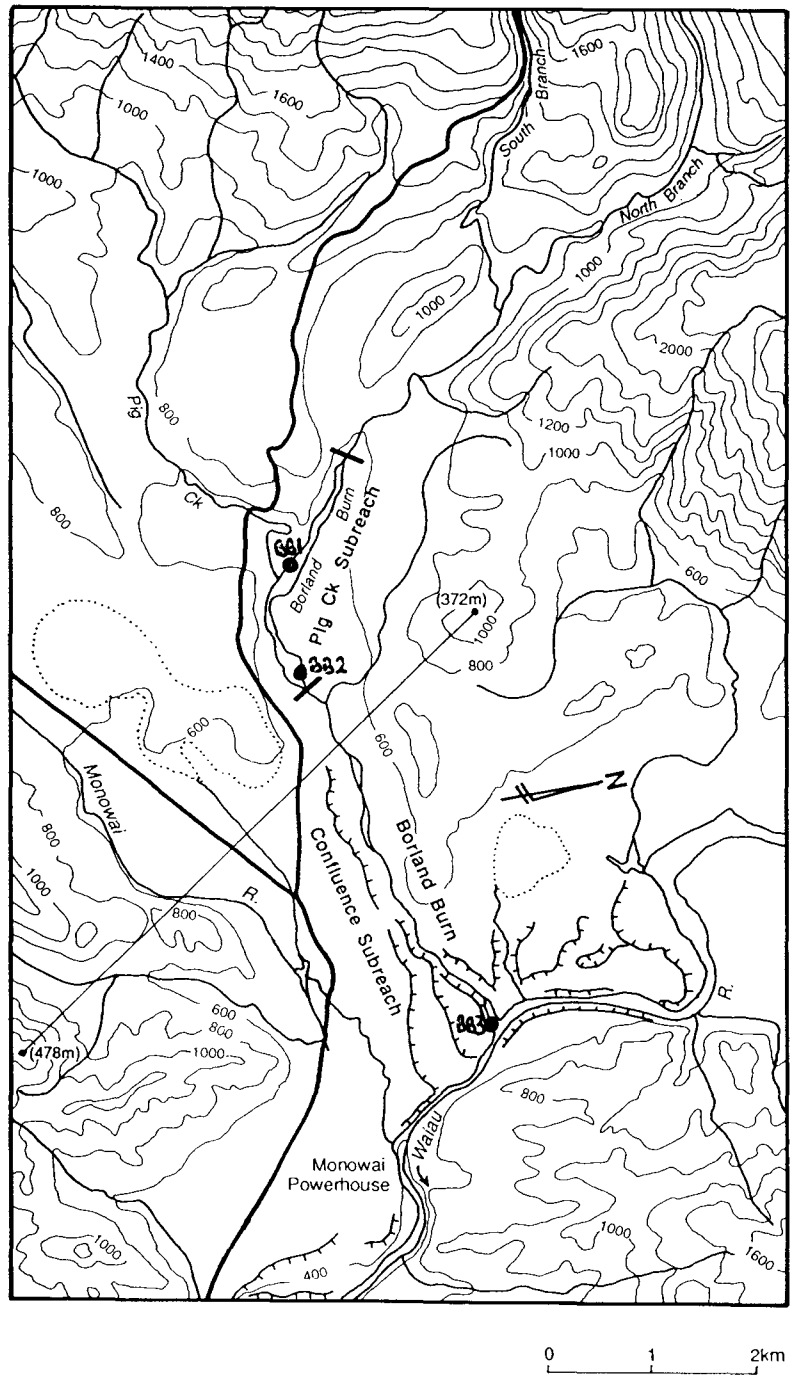
Valley setting

Borland Burn is a relatively narrow valley that drains the steep Hunter Mountains. Three primary streams (North, Middle and South Branches) converge to form Borland Burn itself.

Extent of Valley flat

In general Borland Burn Valley demonstrates the characteristic sequence of valley flat widening downstream. Valley flats extend up to 200 m wide in the upstream sections of North, Middle and South Branches. In general, however, the three upstream branches are very narrow V-shaped valleys, with boulder streams. Valley flats only locally extend to a few tens of metres wide. Downstream of South Branch confluence, the valley widens to about 1 km wide. Valley width increases to about 2.5 km adjacent to Borland Lodge. Beyond this point Borland Burn flows in a broader valley section that it shares with Monowai River. The valley is over 3 km wide in this lower section. Terraces are bedrock based in this downstream section.

BORLAND BURN Monowai (S158) 1:63,360



LEGEND

- Road
- 500 — Contours (feet)
- Terrace riser
- Creeks / rivers
- Cross section
- BB — Sample location
- Reach margin
- Catchment margin

Terrace character
No terraces are evident in South Branch. At least one major terrace is evident on the left bank at Pig Creek. This feature has a dense beech forest cover. Terraces become much more extensive downstream and immediately upstream of the Waiau confluence there is an extensive flight of terraces, especially on the right bank.

Extent of Alluvial flat
South Branch is a true V-shaped valley with a stepped boulder stream. The active active channel zone, with discontinuous, swampy alluvial flats, only extends from GR 513802 to 524798. Immediately upstream of Pig Creek confluence (GR 633759), flats are discontinuous and extend up to a few hundred metres wide. A bank exposure in this subreach indicates that the flats are composed of extremely poorly sorted, clast-supported deposits which may represent an extreme depositional event. Crude bedding within this unit suggests a hyperconcentrated flood flow deposits rather than a debris flow unit. Flats have a hummocky, irregular surface. At the downstream end of Pig Creek subreach, right bank flats are covered with broom, and a former channel surface is observed cutting diagonally through the flats at this point. Beyond this point the river become bedrock-controlled, with no low-level alluvial flats.

Degree and character of channel constriction
The upstream end of the valley is V-shaped and bedrock or boulder controlled. In Pig creek subreach the coarse materials of the valley flats constrain lateral expansion of the channel, but the materials exposed on the channel bed are equally coarse. Pig Creek itself has Papa mudstone on its right bank at the footbridge (GR 632758). Mudstone constrains the channel to a non-alluvial style beyond GR 646759.

Character and impact of tributary streams
Beyond South branch confluence very few tributaries join Borland Burn. A shallow fan has built up at Pig Creek confluence. Pig Creek itself has an active bed of coarse gravels.

Surficial geology
The headwaters of Borland Burn drain the Hunter Mountains, which are composed primarily of metamorphic and igneous rocks of the Bradshaw Formation (i.e. part of the Fiordland Plutonic complex). These are predominantly gneiss and dioritic rocks. These rocks, which are sourced at the headwaters of Borland Burn, are dominant on bar surfaces, with only occasional sedimentary clasts observed. This reflects the greater competence of these rocks relative to the Tertiary quartzo-feldspathic sandstone and mudstones which make up most of the lower catchment (and also Blackmount). The downstream section of Borland Burn is constrained within Papa mudstone.

Vegetation
Valley side/flats : Beech forest with a mossy carpet.

Alluvial flats/Bank/Bars : Open grassy areas with exotic weeds. Toi toi, broom and manuka, along with occasional lupins and rosehip are observed. Many large logs have accumulated on bar surfaces and in chute channels.

Land use
National Park, with access route to Manapouri Power Station. Pasture on terraces downstream.

Direct human impacts
Negligible.

Other comments
A local landowner has noted negligible change in the gravel accumulation at the confluence. Bedrock confinement has induced relative stability on the configuration of the channel and sediment budget at this site. In contrast, an unnamed rightbank tributary of Waiau River upstream of Borland Burn has not only built a small fan at its confluence, but has subsequently incised rapidly upstream.

PIG CREEK SUBREACH (Monowai, GR 622768 to 645659)

CHANNEL CHARACTERISTICS

Number of channels : This moderately alluvial sub-reach is generally divided around well-established flats (with up to three active channels). These channels appear to be relatively stable, pinned as they are by the extremely coarse nature of the materials. Chute channels are evident at bar margins.

Channel geometry : Shallow channel with a large number of boulders. High w:d because of the shallow depth. Large riffles are evident wherever channels rejoin.

Sinuosity : Very low.

Lateral stability of channel(s) : No evident lateral expansion. The channel appears to be relatively stable throughout, although recent right bank erosion is evident immediately upstream of Pig Creek (adjacent to a chute channel). Recent treefalls are also evident.

Bar type and scale
Despite the relatively narrow channelized zone in Pig Creek subreach, bars are complex features and appear to be relatively stable bank-attached and mid-channel compound bars. Rather than representing constructive features, these bars appear to have formed by dissection of alluvial flats. As such, these features are viewed as dissected islands, over which flows have moulded various topographic levels. This suggests that the reach is a partially degrading system as opposed to an actively aggradational regime. Large events seemingly flush large volumes of coarse materials, with subsequent incision into these deposits. Degradational processes are inhibited by the coarse nature of bank and bed materials, so the channel splits. Any finer materials are simply flushed through this reach.

Bed/Bank character (extent and materials)
The bed and bar surfaces are dominated by highly jumbled, very coarse, blocky and subrounded boulders, although sand sheets are evident on bar platforms. The bed has a very coarse lag with mobile gravels (up to 200 mm wide) atop. Distinct clusters and pockets of coarse clasts are evident. Large clasts are occasionally imbricated, and appear to represent major depositional events. Root-attached logs are evident, with occasional log jams. Large clasts at bar margins commonly have a red lichen cover.

Banks appear to have a similar appearance. They are crudely bedded and quite resistant to erosion. Deposits are extremely poorly sorted, with an open framework which has been partially infilled. In some sections of Pig Creek subreach the bank has a cap of fine materials about 0.5 m thick.

Flow character
Shallow, uniform flow, with large, steep-faced riffles.

SAMPLE SITE CHARACTERISTICS

Sample number : **BB1** Analysts : GB, AB

Grid reference : Monowai (1:63,360), NZMS 1, S158; GR 633760

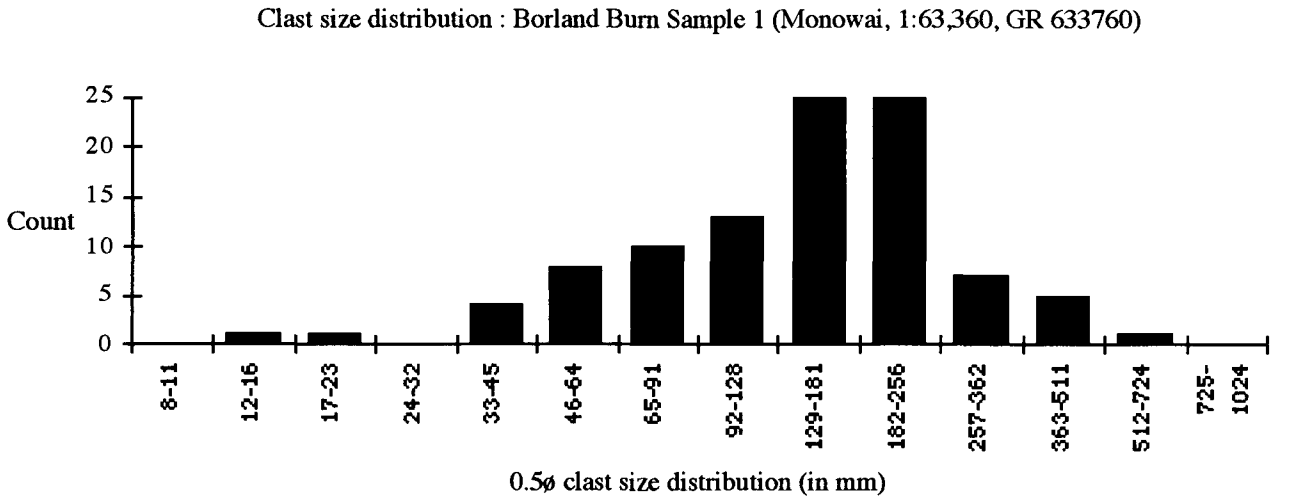
Sample type : 1 x 100 @ 1.0 m interval

Bar type : Bank-attached compound bar, with a distinct chute channel at the right bank. While the bar is predominantly a single unit of coarse, poorly sorted material, there has been considerable reworking of materials by chute channels and Pig Creek has modified the downstream section of this bar. Sand lobes are evident on the highest sections of the bar.

Sample position on bar : Head of bar at the water's edge.

'Particle characteristics'

0.5ø Clast size frequency Histogram



D95 405 mm; D84 233 mm; D50 155 mm; D16 68 mm; D5 37 mm

Mean 167.7 mm; Sorting 103.5 mm

Sorting : Poor, but the 0.5ø clast size distribution is distinctly modal at 129-256 mm.

Packing arrangement : No competent pavement is evident; rather, this appears to be a coarse lag unit, with a highly jumbled appearance. Much sand is also evident atop the higher parts of the bar and in the lee of large particle clusters. Many of the larger granitic boulders are actually breaking down in situ. Surface is composed primarily of loose clasts, with only occasionally wedged or imbricated clasts. There appears to be a distinct grain size gap in the range from sand to 30-50 mm.

Shape : Rounded, blocky.

Lithology : Very mixed; many Fiordland Plutonics.

Other characteristics : Materials appear to be a lag deposit from a high energy depositional event. This may reflect a hyperconcentrated flood flow unit. Much tree trunk debris is evident over the bar surface, with some log jams. Otherwise vegetation is restricted to a few grasses, broom and toi toi.

Sample number : **BB2** Analysts : GB, AB

Grid reference : Monowai (1:63,360), NZMS 1, S158; GR 643757

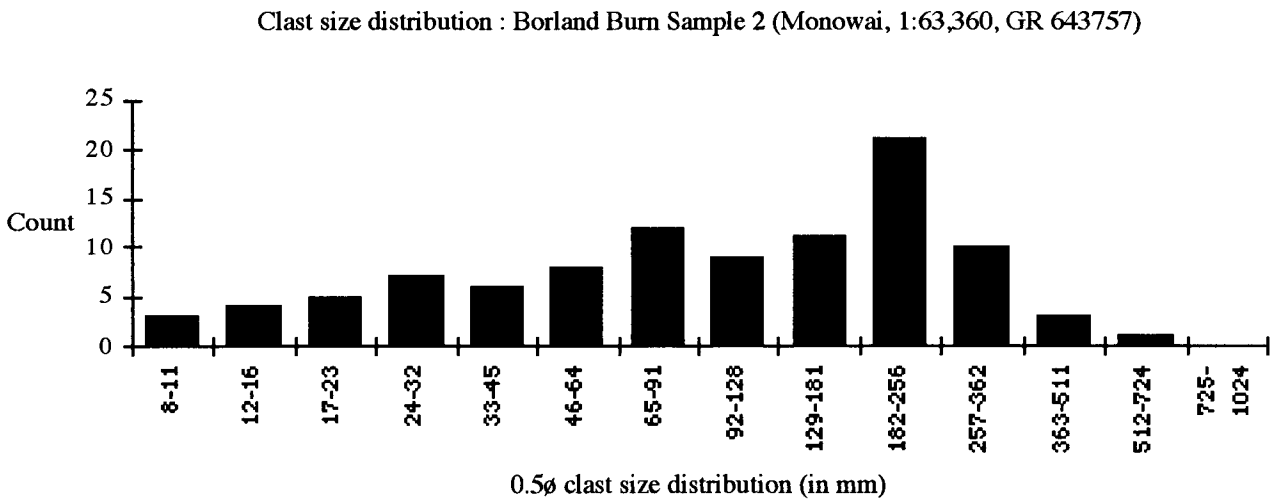
Sample type : 2 x 50 m @ 1.0 m interval

Bar type : Bank-attached compound bar with a riffle sequence at its tail end and a chute channel along the left bank margin. This bar is predominantly composed of a large bar platform unit, with a finer unit at the bar tail. Fine gravels and sands occur in small patches among the coarser basal materials. Sands are draped at the water's edge.

Sample position on bar : Bar head sample, 2 and 5 m from the water's edge.

'Particle characteristics'

0.5ø Clast size frequency Histogram



D95 330 mm; D84 240 mm; D50 110 mm; D16 25 mm; D5 15 mm

Mean 140.7 mm; Sorting 116.1 mm

Sorting : Very poor, with a widely dispersed distribution.

Packing arrangement : No pavement, but large clasts act to trap finer materials (i.e. this is a lag deposit). The bar has a jumbled surface with a number of loose clasts. Many clasts are wedged together with low to moderate imbrication, but many are actually buried within/beneath fine gravels/sands. The bar surface appears to be deficient of materials smaller that 10-15 mm, but this cannot be attributed to winnowing given the prevalence of sand-sized materials over the bar.

Shape : Subrounded to rounded; blocky. Clasts are not as rounded as at sample site BB1.

Lithology : Mixed; predominantly igneous.

Other characteristics : No vegetation on the bar surface. Large clasts have formed the adjacent riffle unit. Smaller gravels appear to be moving over these larger, less mobile clasts. Fines occur in greater abundance beneath a 1-2 clast thick veneer.

Borland Burn Photo 1, Pig Creek subreach
Aerial photograph of Borland Burn, immediately upstream of Borland Lodge. Pig Creek joins Borland Burn on the left hand side at the bottom of the photograph. Note the low sinuosity section of Borland Burn, with occasional channel division around stable islands. Sample site BB1 was located on the bank attached compound bar upstream of Pig Creek.
16.01.93 AHF 2/16



Borland Burn Photo 2, Pig Creek subreach
View upstream at Sample site BB1. Note the densely vegetated banks, and the abundant logs and organic debris spread over the bar surface.
25.01.93 7-36 Monowai (S158) 1:63,360, GR 633760



Borland Burn Photo 3, Pig Creek subreach
Chute channel on the right bank adjacent to Sample site BB1. Note the coarse boulder deposits in the bank, and the log jam downstream.
25.01.93 8/X Monowai (S158) 1:63,360, GR 634759



Borland Burn Photo 4, Pig Creek subreach
View downstream from Sample site BB1, with Pig Creek confluence on the right hand side.
25.01.93 8/0 Monowai (S158) 1:63,360, GR 634758



Borland Burn Photo 5, Pig Creek subreach
View downstream along the lower course of Pig Creek. Note the alternating bar sequence. Bars are composed of moderately loose, coarse clasts.
25.01.93 8/1 Monowai (S158) 1:63,360, GR 633758



Borland Burn Photo 6, Pig Creek subreach
Sample site BB2, located on a bank-attached compound bar at the downstream end of the divided channel section of Borland Burn a few kilometres downstream of Borland Lodge. Note the large log jam at the head of the mid-channel bar downstream.
25.01.93 8/3 Monowai (S158) 1:63,360, GR 643757



Borland Burn Photo 7, Pig Creek subreach
The downstream end of Pig Creek subreach. Beyond the bedrock constraint on the left bank, Borland Burn become single-channelled and laterally confined. The relative stability of some of the upper gravel surfaces is evidenced by the red algal growth on the right bank gravels in the background. View looking downstream.
25.01.93 8/4 Monowai (S158) 1:63,360, GR 655759



BORLAND BURN CONFLUENCE SUBREACH (Monowai, GR 645659 to 685772)

CHANNEL CHARACTERISTICS

Number of channels : The channel is bedrock-confined and single-channelled.

Channel geometry : Shallow channel with a bedrock base.

Sinuosity : Very low. Flow alternates around lateral bars at the head of the subreach.

Lateral stability of channel(s) : Channel is confined and stable in this bedrock-controlled reaches. Some large pools attest to the erosive effectiveness of flood flows.

Bar type and scale
Very few bars are evident in Borland Burn confluence subreach, as gravels are effectively flushed through the reach. A series of alternating lateral bars have developed on the less constrained section between GR 653762 and 664 763. Downstream of this section, a small point bar on the bend at GR 669764 and a bedrock-based lateral bar has accumulated downstream of the bridge at GR 675766 and immediately upstream of the confluence at GR 684772. At Waiau confluence a shallow bedrock-based confluence bar has developed.

Bed/Bank character (extent and materials)
The bed and bar surfaces are dominated by jumbled, very coarse, blocky and subrounded boulders. Gravels have been effectively flushed from the bed, as the channel flows over bedrock. The steeply inclined nature of the bedrock, with bedded units of differential resistance to erosion, has resulted in a stepped profile of the bed immediately upstream of the confluence.

Bedrock banks are resistant to erosion and are commonly quite steep. In general banks are densely vegetated.

Flow character
Flow is generally irregular, with occasional large pools that have formed as the channel abuts against bedrock (e.g. GR 646759).

SAMPLE SITE CHARACTERISTICS

Sample number : **BB3** Analysts : GB, AB

Grid reference : Monowai (1:63,360), NZMS 1, S158; GR 904798

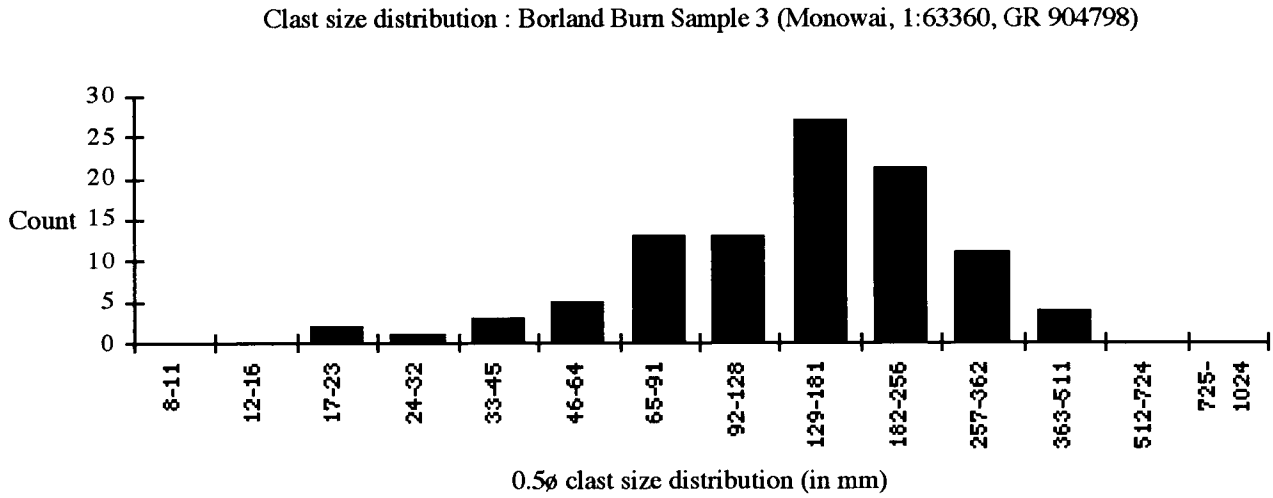
Sample type : 2 x 50 m @ 1.0 m

Bar type : Lateral bar a few clasts thick atop a bedrock bench immediately upstream of Waiau confluence.

Sample position on bar : In the coarsest gravel unit, roughly at mid-bar. Two transects were completed, 2 and 5 m from the water's edge.

'Particle characteristics'

0.5ø Clast size frequency Histogram



D95 300 mm; D84 253 mm; D50 154 mm; D16 75 mm; D5 42 mm

Mean 163.00 mm; Sorting 88.4 mm

Sorting : Poor

Packing arrangement : Jumbled, moderately packed surface with relatively loose clasts resting atop a moderately imbricated surface. Winnowed to 40-50 mm, with occasional fines caught between larger clasts.

Shape : Subrounded to rounded; blocky.

Lithology : Fiordland Plutonics, with occasional foliated white gneisses resting on a mudstone basement.

Other characteristics : Borland Burn forms a shallow lens of coarse clasts on a bedrock ledge in the Waiau itself. This bench has clasts imbricated down-Waiau at its head. These clasts have a clearly different lithology to those contributed by Borland Burn itself. The latter, white-coloured clasts are imbricated down-Borland Burn and form a lens at the downstream half of the within-Waiau accumulation. Given the lateral confinement of Borland Burn, and availability of coarse materials, the downstream half of the lens appears to be coarser than the upstream half composed of materials brought down the Waiau.

Borland Burn Photo 8, Borland Burn Confluence subreach
View upstream of bedrock-constrained Borland Burn, in its lower course. Note the tilted sedimentary strata, composed of Papa mudstone. This bedrock extends over the channel bed. Other than the gravel accumulation on the inside of the bend, the bed is clear of gravels, and the reach is effectively flushed.
25.01.93 8/5 Monowai (S158) 1:63,360, GR 669764



Borland Burn Photo 9, Borland Burn Confluence subreach
View downstream in confined, bedrock constrained reach of lower Borland Burn.
25.01.93 8/7 Monowai (S158) 1:63,360, GR 674766



Borland Burn Photo 10, Borland Burn Confluence subreach
Bedrock constraints on both banks and the bed of Borland Burn immediately upstream of Waiau River. Sample site BB3 was located on the right-bank lateral bar in mid-photo.
25.01.93 8/10 Monowai (S158) 1:63,360, GR 685772
Takitimu (D44) 1:50,000, GR 904798



Borland Burn Photo 11, Borland Burn Confluence subreach
Borland Burn- Waiau confluence. Note the bedrock base of the very shallow clast and boulder accumulation at the mouth of Borland Burn, and bedrock-constriction of Waiau River downstream.
25.01.93 8/11. Monowai (S158) 1:63,360, GR 685772
Takitimu (D44) 1:50,000, GR 705799



Borland Burn Photo 12, Borland Burn Confluence subreach
The extensive gravel accumulation at Waiau River-Borland Burn confluence. The volume of gravels is relatively small, however, as they rest atop a bedrock base. Clasts on the upstream section of this bar appears to be finer than the section downstrean of Borland Burn. Photograph is taken looking down the Waiau Valley.
25.01.93 8/13 Monowai (S158) 1:63,360, GR 685773
Takitimu (D44) 1:50,000, GR 903800

