

Inglewood Metal Limited  
Quarry Monitoring Programme  
Annual Report  
2012-2013

Technical Report 2013-28

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## Executive summary

Inglewood Metal Ltd operates a quarry located at Everett Road in the Kurapete catchment. The Company holds a resource consent to allow it to discharge treated washwater, stormwater and groundwater into an unnamed tributary of the Kurapete Stream. The quarry treats washwater and stormwater/groundwater within a series of retention/settlement ponds within the quarry pit and also at normal ground level, and utilises washwater re-circulation as much as possible. This report for the period July 2012-June 2013 describes the monitoring programme implemented by the Taranaki Regional Council to assess the Company's environmental performance during the period under review, and the results and effects of the Company's activities.

The Company holds one resource consent, which includes a total of fifteen special conditions setting out the requirements that the Company must satisfy. This renewed consent was granted in May 2004 for a period expiring in June 2015. The most recent optional review in June 2012 was not considered necessary to invoke.

The Council's monitoring programme included six scheduled inspections (including on-site liaison with management staff), three discharge and three receiving water physicochemical surveys, and one biological survey of receiving waters.

Over the 2012-2013 year the Inglewood Metal Ltd quarry site has demonstrated a high level of environmental performance and compliance with its resource consent, continuing the trend of improved performance in recent years. There were no incidents recorded during the monitoring year. Monitoring of the site has shown that, under varying receiving water flow conditions, the Inglewood Metal Ltd quarry site had very minor impacts on the appearance of the receiving waters of the Kurapete Stream and on all occasions, was compliant with receiving water consent conditions. Good maintenance of the settlement facilities resulted in reduced suspended solids loadings and lessened the turbidity impact on the Kurapete Stream at all times during the monitoring year, with effects on the receiving environment of the Kurapete Stream generally found to be insignificant (with minimal re-suspension of fine sediment in the receiving water tributary). Previous reconfiguration of the combined washwater and quarry pit stormwater/groundwater treatment ponds system resulted in compliance with wastewater discharge conditions on all occasions. Minimal impacts on the biological community of the stream were found during a very low flow, late summer period, coincident with minor silt deposition on the streambed and no visual impacts on water quality a short distance downstream beyond the consented mixing zone.

The construction of larger silt ponds on the quarry lower floor area and better use of their retention capabilities has helped to improve containment of quarry silts, thereby reducing the turbidity effects in the receiving waters, particularly as the active quarry stormwater catchment has increased in area and iron-laden groundwater compounds turbidity issues. Also containment of the washwater recirculation system has been essential to avoid overloading of the fine silt content of the final wastewater pond discharge. These matters were discussed with the quarry manager at the time of appropriate inspection visits and were maintained during the period under review.

Fencing and planting of the DOC reserve on both banks of the Kurapete Stream from downstream of the unnamed tributary to the Everett Road bridge, which was completed in the 2003-2004 year, together with more recent riparian fencing and planting along the remaining bank of the tributary stream, have also mitigated the effects on the Kurapete

Stream, and significantly added to the aesthetic value of the lower stream reach. These factors, together with the upstream diversion of the Inglewood municipal wastewater out of the catchment, have contributed to improved biological health in this lower reach of the stream.

This report includes recommendations for the 2013-2014 monitoring year including a refund in relation to programmed monitoring activities which were unnecessary during the period.

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# **1. Introduction**

## **1.1 Compliance monitoring programme reports and the Resource Management Act 1991**

### **1.1.1 Introduction**

This report is the Annual Report for the period July 2012-June 2013 by the Taranaki Regional Council on the monitoring programme associated with a resource consent held by Inglewood Metal Ltd. The Company operates a quarry situated at Everett Road, Inglewood.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consent held by Inglewood Metal Ltd that relate to discharges of treated wastes (consent number 1113) within the Kurapete catchment. This is the eighteenth Annual Report to be prepared by the Taranaki Regional Council to cover the Company's stormwater and washwater discharges and their effects.

### **1.1.2 Structure of this report**

Section 1 of this report is a background section. It sets out general information about compliance monitoring under the Resource Management Act and the Council's obligations and general approach to monitoring sites through annual programmes, the resource consents held by Inglewood Metal Ltd in the Kurapete catchment, the nature of the monitoring programme in place for the period under review, and a description of the activities and operations conducted in the lower Kurapete Stream catchment.

Section 2 presents the results of monitoring during the period under review, including scientific and technical data.

Section 3 discusses the results, their interpretation, and their significance for the environment.

Section 4 presents recommendations to be implemented in the 2012-2013 monitoring year.

A glossary of common abbreviations and scientific terms, and a bibliography, are presented at the end of the report.

### **1.1.3 The Resource Management Act (1991) and monitoring**

The Resource Management Act primarily addresses environmental 'effects' which are defined as positive or adverse, temporary or permanent, past, present or future, or cumulative. Effects may arise in relation to:

- (a) the neighbourhood or the wider community around a discharger, and may include cultural and socio-economic effects;
- (b) physical effects on the locality, including landscape, amenity and visual effects
- (c) ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;

- (d) natural and physical resources having special significance (eg, recreational, cultural, or aesthetic);
- (e) risks to the neighbourhood or environment.

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, the Taranaki Regional Council is recognising the comprehensive meaning of 'effects' inasmuch as is appropriate for each discharge source. Monitoring programmes are not only based on existing permit conditions, but also on the obligations of the Resource Management Act to assess the effects of the exercise of consents. In accordance with section 35 of the Resource Management Act 1991, the Council undertakes compliance monitoring for consents and rules in regional plans; and maintains an overview of performance of resource users against regional plans and consents. Compliance monitoring, including impact monitoring, also enables the Council to continuously assess its own performance in resource management as well as that of resource users particularly consent holders. It further enables the Council to continually re-evaluate its approach and that of consent holders to resource management, and, ultimately, through the refinement of methods, to move closer to achieving sustainable development of the region's resources.

#### 1.1.4 Evaluation of environmental performance

Besides discussing the various details of the performance and extent of compliance by the Inglewood Metal Ltd quarry in the Kurapete catchment during the period under review, this report also assigns an overall rating. The categories used by the Council, and their interpretation, are as follows:

- a **high** level of environmental performance and compliance indicates that essentially there were no adverse environmental effects to be concerned about, and no, or inconsequential (such as data supplied after a deadline) non-compliance with conditions.
- a **good** level of environmental performance and compliance indicates that adverse environmental effects of activities during the monitoring period were negligible or minor at most, or, the Council did not record any verified unauthorised incidents involving significant environmental impacts and was not obliged to issue any abatement notices or infringement notices, or, there were perhaps some items noted on inspection notices for attention but these items were not urgent nor critical, and follow-up inspections showed they have been dealt with, and inconsequential non-compliances with conditions were resolved positively, co-operatively, and quickly.
- **improvement desirable** indicates that the Council may have been obliged to record a verified unauthorised incident involving measureable environmental impacts, or, there were measureable environmental effects arising from activities and intervention by Council staff was required, and there were matters that required urgent intervention, took some time to resolve, or remained unresolved at end of the period under review, and/or abatement notices may have been issued.



- **poor performance** indicates that the Council may have been obliged to record a verified unauthorised incident involving significant environmental impacts, or, there were adverse environmental effects arising from activities and there were grounds for prosecution or an infringement notice.

## 1.2 Process description

The Inglewood Metal Ltd quarrying operation is located to the true right of the Kurapete Stream at Everett Road, near Inglewood. Some washing is performed at the site and the machinery includes a dry crusher and a washing and screening plant.

Waste washwater is directed through a series of settling ponds before being either reticulated for use in washing or discharged via a further series of ponds to the head of the unnamed tributary. The quarrying area is contoured and bunded so that groundwater and stormwater are directed back to the settling ponds in the base of the quarry floor (Figure 1) before being pumped to the pond system for washing or discharging through to the final pond and then to an unnamed tributary of the Kurapete Stream. Over recent years there has been some variability in the configuration of the upper settlement ponds system receiving the quarry floor wastewater prior to discharge to the stream.

Discharge from the final treatment pond is via a steel pipe access culvert to the unnamed tributary of the Kurapete Stream which flows approximately 600 metres before joining the Kurapete Stream upstream of the Everett Road Bridge.

Gravel filtered surface runoff from the entrance to the quarry, off Everett Road, and the upstream farm drainage enter the northern boundary drain which discharges into the unnamed tributary (Figure 1).

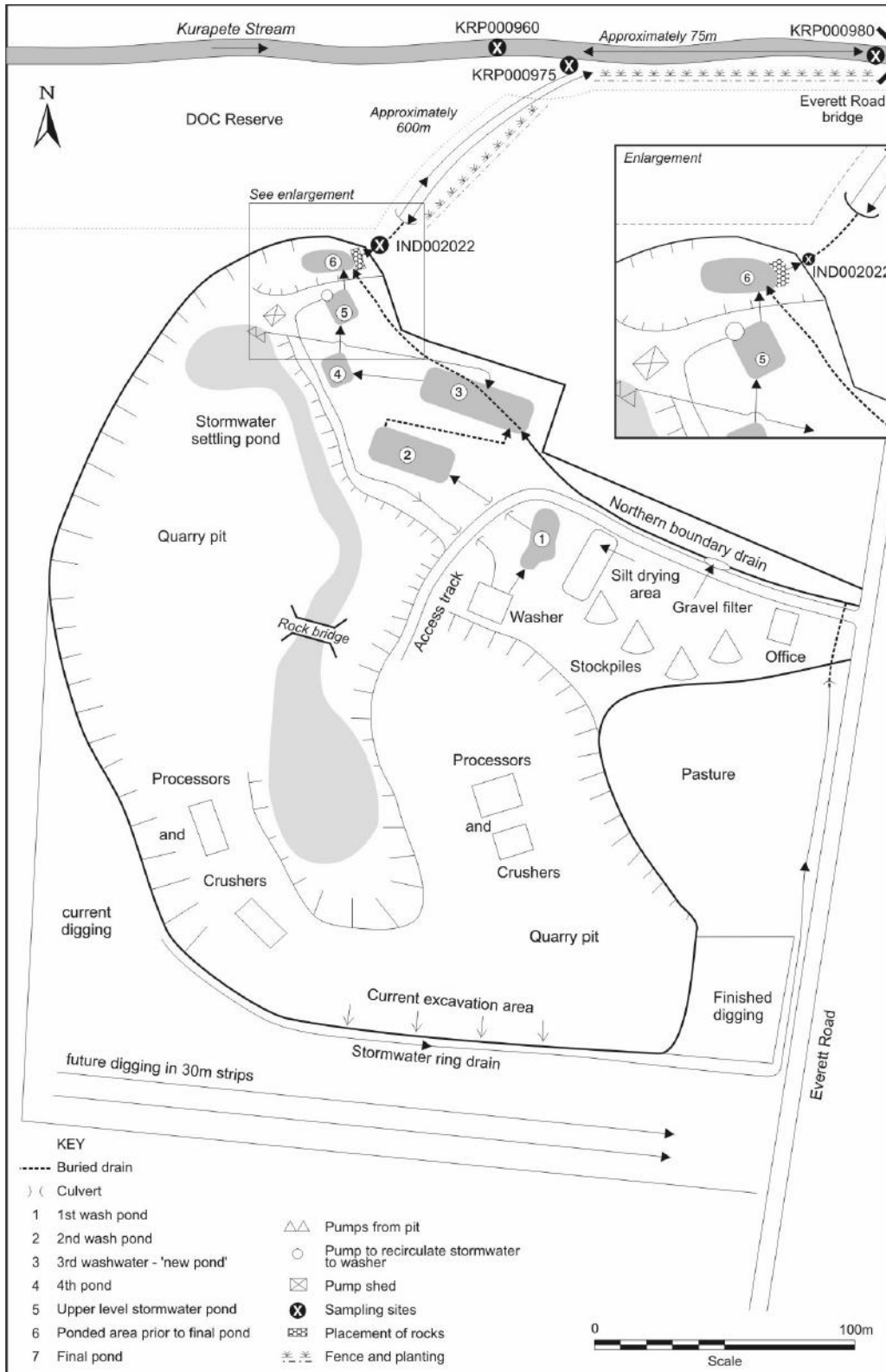
Quarry management had advised that the quarry face would continue to be excavated and in recent years larger ponds have been constructed on the quarry floor for improved retention and settlement of turbid groundwater and stormwater prior to pumping to the upper ponds' treatment system.

## 1.3 Resource consents

### 1.3.1 General

In the past, a large percentage of aggregate production came from river-based sites within Taranaki. The Waiwhakaiho River supplied much of New Plymouth's requirements as far back as the 1950s with the Waitara River, Waiongana River, Kapuni Stream and Waingongoro River also providing a valuable source of aggregate. The aggregate source within these rivers was often over-exploited. The protective armouring of the boulders and gravel was removed in places, exposing the underlying erodible ash beds and creating deep narrow channels, which moved progressively upstream with no noticeable recovery. This brought about the need for the Shingle Extraction Bylaw introduced in 1974. Aggregate extraction from rivers was then controlled through the issue of permits accompanied by a set of conditions, with the removal of river-based aggregate being restricted to that for river control purposes only.

Historically, land-based sites required steady markets to compete with the easily won river-based extraction operations. However, in the early 1980s, due to the restriction placed on river-based aggregate extraction (and the completion of various major river control programmes and 'Think Big' projects) land-based sites became more widespread (Taranaki Regional Council, 1992)



**Figure 1** Quarry operations, wastewater treatment system and location of sampling sites

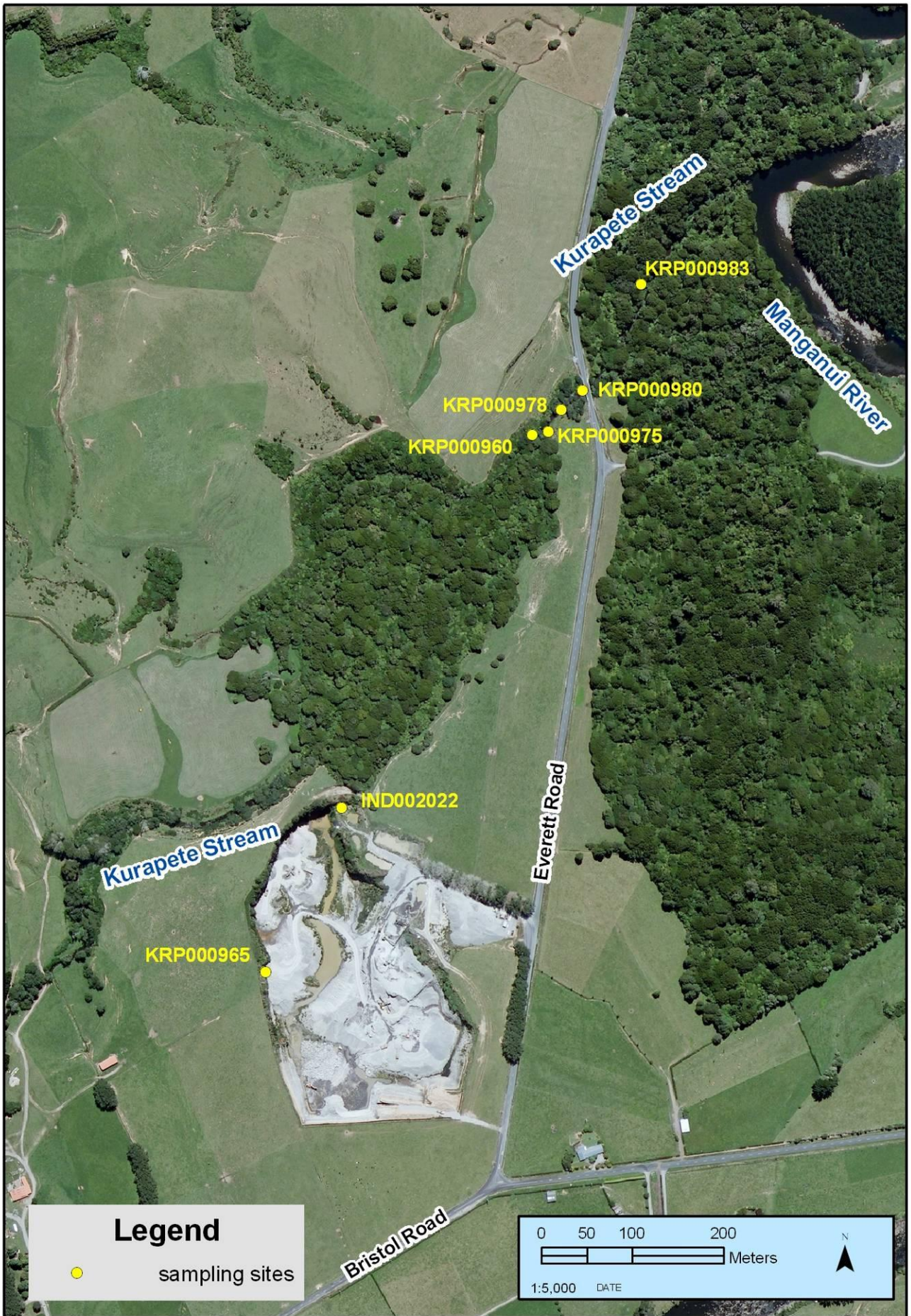


Figure 2 Aerial location map

Twenty-nine operating quarries presently supplying aggregate in Taranaki are monitored for consent compliance. These quarries are generally located in reasonable proximity to urban areas, from which the greatest demand for aggregate stems.

Provision of aggregate to meet longer-term demand will continue to be dominated by several large quarry operations. Extra demand on alluvial terraces and laharic deposits has occurred due to the controlled river bed extraction. These resources are of good quality and are relatively plentiful, although Taranaki aggregates are known to have a lower crushing strength [85 kN] than aggregates from most other parts of New Zealand. Importation of various aggregates may need to continue to meet the requirement for aggregate types not available in Taranaki.

Quarrying and shingle extraction in Taranaki is covered by the Resource Management Act and, if the minerals in question are Crown owned, by the Crown Minerals Act 1991.

Regional councils have no control over the provision of exclusive rights to minerals. However, regional councils do have control over the environmental effects of aggregate extraction from river and lake beds, and land in certain circumstances, and these controls may act as a constraint or limitation on allocation decisions.

Sections 15 and 30 of the Resource Management Act 1991 give regional councils responsibility for the discharge of contaminants into the environment. Discharges of water into water, contaminants onto or into land that may result in water contamination, and contaminants from industrial premises into air or onto/into land, may not take place unless expressly allowed by a rule in a regional plan, a resource consent, or regulations.

Aggregate extraction usually involves washing aggregates, and therefore requires the discharge of wastes. Other discharges, such as emissions to air from crushing and processing plants, disposal of spoil and solid wastes, and discharges of stormwater are also the responsibility of regional councils.

### **1.3.2 Water abstraction permit**

Inglewood Metal previously held a resource consent to abstract surface water for washing metal. Water from the final washwater ponds is now recirculated and used for washing. Therefore a consent was no longer required and the resource consent (1112) was surrendered at the time of its expiry.

### **1.3.3 Water discharge permit**

Section 15(1) (a) of the Resource Management Act stipulates that no person may discharge any contaminant into water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or by national regulations.

Water quality is a primary concern to the Regional Council with regard to aggregate extraction. A quarry can operate as either a 'dry' quarry discharging only stormwater or a 'washing' quarry where aggregate washing facilities are in place. Many of the quarries in Taranaki have some form of washing facility and also operate in the vicinity of a water body or have some form of discharge into a water body.

Waste water from aggregate washing has a high silt concentration. Discharge of this water into a waterbody, particularly to a stream during low flow, can result in smothering of instream life and deterioration in aesthetic conditions and can affect downstream abstractions of water, local fisheries and recreational activity.

Stormwater is generally less contaminated (in terms of silt concentration) and run-off tends to occur when rivers and streams are in higher flow. This means that the effect of silt contamination is reduced due to lower quantities, greater dilution, and increased carrying capacity. The installation of appropriate stormwater diversion structures, together with construction and maintenance of contaminated stormwater and aggregate washing discharge treatment facilities, are most important in maintaining water quality.

Inglewood Metal Ltd currently holds discharge consent 1113-4 to cover the discharge of treated stormwater (including groundwater seepage) and treated washwater into an unnamed tributary of the Kurapete Stream. This consent (see Appendix I) was renewed by the Taranaki Regional Council on 20 May 2004 as a resource consent under Section 87(e) of the Resource Management Act. It expires on 1 June 2015.

There are fifteen special conditions associated with the discharge permit 1113-4. Of these, eight conditions relate to the operation and management of quarrying activities and the treatment system; two conditions are related to reinstatement requirements; one condition requires provision of contingency planning; and three conditions relate to treated wastewater quality and limit effects of the discharge on the receiving water (Kurapete Stream) quality. A further condition provides for review of the consent should this be necessary.

## **1.4 Monitoring programme: water**

### **1.4.1 Introduction**

Section 35 of the Resource Management Act sets out an obligation for the Taranaki Regional Council to gather information, monitor, and conduct research on the exercise of resource consents, and the effects arising, within the Taranaki region.

The Taranaki Regional Council may therefore make and record measurements of physical and chemical parameters, take samples for analysis, carry out surveys and inspections, conduct investigations, and seek information from consent holders.

The monitoring programme for the Inglewood Metal Ltd site consisted of four primary components.

### **1.4.2 Programme liaison and management**

There is generally a significant investment of time and resources by the Taranaki Regional Council in ongoing liaison with resource consent holders over consent conditions and their interpretation and application, in discussion over monitoring requirements, preparation for any reviews, renewals, or new consents, advice on the Council's environmental management strategies and the content of regional plans, and consultation on associated matters.

### **1.4.3 Site inspections**

The Inglewood Metal Ltd site was visited six times during the monitoring period. The main points of interest were plant processes with potential or actual discharges to receiving watercourses, including contaminated stormwater and process wastewaters. The neighbourhood and particularly the receiving waters were surveyed for environmental effects. Changes to the quarry operations contingency plan had included the installation of larger silt traps/settling ponds on the lower quarry floor during the 2006-2007 period.

### **1.4.4 Physicochemical sampling**

Taranaki Regional Council undertook sampling of discharges from the site and the water quality upstream and downstream of the discharge point and mixing zone in the Kurapete Stream.

The Inglewood Metal Ltd discharge was sampled on three occasions. On each of these occasions samples of the receiving waters were also collected at the end of the unnamed tributary prior to the confluence with the Kurapete Stream and in the Kurapete Stream upstream of the tributary discharge and downstream beyond the 25 metre mixing zone. The samples were analysed for pH, turbidity, conductivity and suspended solids. No discharge was occurring at the time of two inspection occasions and no significant visual impacts were apparent at the time of another of these inspections and therefore no receiving water surveys were required. (Note: These costs, as scheduled components of the programme, will be refunded).

### **1.4.5 Biological survey**

One biological survey of the Kurapete Stream was conducted at three sites, one upstream and two downstream of the confluence with the unnamed tributary. This survey was conducted in February 2013, eighteen days after the most recent stream fresh and during a late summer very low flow recession period.

## 2. Results

### 2.1 Water

#### 2.1.1 Inspections and results of discharge and receiving water monitoring

During the 2012-2013 monitoring period six scheduled inspections of the Inglewood Metal Ltd quarry site were conducted by an officer of the Taranaki Regional Council. Water samples were collected for physicochemical analysis on three occasions from the discharge and on the same three occasions from the receiving water sites located as shown in Figures 1 and 2 and described in Table 1. There was no noticeable hydrocarbon sheen on the final pond on any inspection occasion and therefore there was no requirement for such analytical measurements for compliance purposes.

**Table 1** Location of sampling sites

Site	Location	GPS location	Site code
Kurapete Stream	100m u/s of Everett Road bridge (upstream of quarry tributary)	1710640E 5668709N	KRP000960
Quarry washwater / stormwater	at discharge outlets (NB sw included after Feb 1998)	1710431E 5668301N	IND002022
Unnamed tributary	5m u/s of the Kurapete Stream confluence (600m downstream of discharges at quarry)	1710658E 5668713N	KRP000975
Kurapete Stream	At the Everett Road bridge (approximately 100m d/s of quarry tributary)	1710695E 5668758N	KRP000980

There was stable quarry management after another change in personnel in the 2011-2012 monitoring period during which there was the appointment of a new manager. Comments associated with the meeting, inspections (with the quarry manager on site), and the results of sampling activities are as follows:

#### **Inspection of 7 August 2012**

This inspection was conducted following wet weather conditions. No processing or washing were occurring on site. The northern boundary drain had become blocked with subsequent flooding of the surrounding paddock. This was unblocked earlier in the day.

Stormwater and groundwater were being pumped from the floor of the quarry to the third pond of the upper ponds which provided increased settlement prior to discharge. A moderate rate of discharge was occurring from the final (sixth) pond to the tributary but there were no visual impacts of this tributary on the appearance of the Kurapete Stream at the boundary of the mixing zone as stream flow was high and turbid. No sampling of the wastewater discharge or the receiving waters was undertaken as a consequence.

#### **Inspection of 6 November 2012**

The next routine inspection was conducted during fine weather. The quarry was operating but there was no pumping of stormwater from the quarry floor occurring. It was noted that no washing was occurring at the time. Crushing was operating at the lower plant and a large quantity of product was stockpiled on site. The extraction area had expanded to the south toward Bristol Road.

Despite the above, the final pond in the system was discharging at a steady rate to the unnamed tributary which was slightly discoloured at the confluence with the Kurapete Stream, and the receiving waters of the Kurapete Stream were relatively low and slightly turbid in appearance at the boundary of the mixing zone. Wastewater and receiving water sampling were undertaken with these results presented in Table 2.

**Table 2** Results from Inglewood Metal Ltd quarry monitoring sampled on 6 November 2012

Site location		IND002022 Quarry stormwater	KRP000975 Tributary S downstream	KRP000960 Kurapete S upstream	KRP000980 Kurapete S downstream
Parameter	Unit				
Time	NZST	1000	1015	1020	1010
Suspended Solids	g/m <sup>3</sup>	28	29	<2	6
Turbidity	NTU	35	32	1.5	5.8
Conductivity @20°C	mS/m	27.8	26.7	11.0	13.8
pH		7.7	7.6	7.6	7.6
Appearance		slightly turbid	slightly turbid	clear	slightly turbid

These results indicated that the treated wastewater discharge was in compliance with special condition 10 of the consent. There was a slight visual impact beyond the mixing zone in the receiving waters of the Kurapete Stream (where the dilution of the tributary flow was approximately 5:1). The increase in suspended solids concentration between the upstream and downstream sites in this stream was in compliance with the relevant special condition 12 (a) despite an increase in turbidity caused by the fine, colloidal particles suspended in the water column.

### Inspection of 5 March 2013

This inspection was performed under dry weather conditions after a particularly dry late summer period. The crushing plants were operating on the quarry floor but no washing of product was occurring as the washing plant was non-operational at the time. The initial settlement pond had recently been cleaned out. Wastes from the settlement pond system on the quarry pit floor were not being pumped to the third (upper) treatment pond as the quarry floor ponds and ring drains were at very low levels. A sampling survey was not required as only a very small trickle discharge was occurring from the final pond to the unnamed tributary and there was no visual impact on the main Kurapete Stream which was clear and uncoloured at the time of the inspection. There was no dust discharging beyond the site which was tidy at the time of the inspection.

There was inspectorial assessment of compliance with the relevant special conditions 11 (a) and 11 (b) in relation to aesthetic impacts on the receiving waters of the Kurapete Stream.



### Inspection of 13 March 2012

A dry weather inspection was performed during a reasonably busy period of crushing and a large amount of stockpiling of product. The extraction area was tidy. Washing was being performed and there was pumping of the quarry pit stormwater ponds to the third upper pond but no discharge from the final (sixth) upper pond to the unnamed tributary stream. There was no increase in turbidity noted in the low flow of the Kurapete Stream below the tributary confluence after the consented mixing zone, and therefore no sampling of the receiving waters or wastewater was undertaken.

### Inspection of 24 May 2013

This inspection was performed following recent wet weather conditions. The site was busy at the time of the inspection with processing of product. The quarry pit area was tidy and no washing was taking place. Pumping of stormwater from the quarry pit to the third upper pond was occurring with a high rate of discharge from the final pond to the unnamed tributary. There was slight discolouration from the tributary, over a short distance (five metres) within the mixing zone of the Kurapete Stream which was in relatively high, slightly turbid flow upstream and at the Everett Road bridge. Sampling of wastewater and in the receiving waters was performed. The sampling results are presented in Table 3.

**Table 3** Results from Inglewood Metal Ltd quarry monitoring sampled on 24 May 2013

Site location		IND002022 Quarry stormwater	KRP000975 Tributary S downstream	KRP000960 Kurapete S upstream	KRP000980 Kurapete S downstream
Parameter	Unit				
Time	NZST	0850	0910	0915	0900
Suspended Solids	g/m <sup>3</sup>	14	11	6	6
Turbidity	NTU	19	13	3.5	4.1
Conductivity @20°C	mS/m	25.8	24.2	10.2	11.1
pH		7.6	7.4	7.4	7.4
Appearance		relatively clear, high flow	slightly turbid	slightly turbid, high flow	slightly turbid, high flow

These results indicated that the treated wastewater discharge was in compliance with special condition 10 of the consent. There was no visual impact beyond the mixing zone in the slightly turbid receiving waters of the Kurapete Stream (where dilution of the tributary was approximately 15:1). The absence of any increase in suspended solids concentration between the upstream and downstream sites in this stream was in compliance with the relevant special condition 12 (a) consistent with a very small increase in turbidity caused by the fine, colloidal particles suspended in the water column.

### Inspection of 26 June 2013

This inspection was performed a week after wet weather, and during fine weather conditions. The site was not as busy as usual at the time of the inspection with crushing of product at only one of the plants. Quarrying along the Bristol Road edge was intended in the near future. The quarry pit area was tidy with pumping of stormwater from the quarry pit to the third upper pond occurring with a moderate rate of discharge from the final pond. No washing was taking place. Sampling of the

wastewater and in the receiving waters was performed. The sampling results are presented in Table 4.

**Table 4** Results from Inglewood Metal Ltd quarry monitoring sampled on 26 June 2013

Site location		IND002022 Quarry stormwater	KRP000975 Tributary S downstream	KRP000960 Kurapete S upstream	KRP000980 Kurapete S downstream
Parameter	Unit				
Time	NZST	0930	0945	0950	0940
Suspended Solids	g/m <sup>3</sup>	8	8	2	3
Turbidity	NTU	18	11	1.8	3.0
Conductivity @20°C	mS/m	30.5	26.8	10.3	12.7
pH		7.5	7.3	7.5	7.5
Appearance		relatively clear	slightly turbid	clear	clear

These results indicated that the treated wastewater discharge was in compliance with special condition 10 of the consent. There was no visual impact beyond the mixing zone in the receiving waters of the Kurapete Stream (where dilution of the tributary was approximately 6:1). The very small increase in suspended solids concentration between the upstream and downstream sites in this stream was in compliance with the relevant special condition 12 (a) coincident with a small increase in turbidity caused by the fine, colloidal particles suspended in the water column.

## 2.1.2 Freshwater biological monitoring

### 2.2.1.1 Introduction

One of a number of recommendations contained in the 1995-1996 Annual Report (TRC 96-15c) stated that the monitoring programme should include a summer biomonitoring survey performed in the lower reaches of the Kurapete Stream. This requirement was made in recognition of the fisheries importance of the lower reaches of this stream, and because the consent compliance record at that time indicated a need for a form of monitoring which provided longer-term evaluation of potential siltation effects on receiving water quality.

Some subsequent biomonitoring surveys (see TRC, 2004, TRC, 2008, and TRC, 2010) have found evidence of macroinvertebrate faunal community deterioration in the Kurapete Stream, beyond the boundary of the mixing zone, 50 metres downstream of the confluence with the small tributary which drained the quarry area. However, other surveys have found limited, but insignificant, impacts on this reach of the Kurapete Stream. Some of these improvements were coincidental with the upgrade to quarry wastewater treatment systems instigated in the 1998-99 monitoring period and improved maintenance of these systems since this time.

From time-to-time, variability in the impacts on the macroinvertebrate communities of the Kurapete Stream may have been related to confounding issues of upstream water quality improvement subsequent to the diversion of the Inglewood oxidation pond systems wastes out of the catchment. Cattle access and lack of riparian vegetation in the proximity of the downstream site, on some occasions may have accentuated the variability of these impacts. An additional site was included in some recent biomonitoring surveys to assess the extent of such effects (TRC, 2004, TRC,

2005, TRC, 2007, TRC, 2008, TRC, 2009, and TRC, 2010) but it was not required for the current survey because of the relative absence of visual impacts on the receiving waters and limited substrate sedimentation noted at the time of the survey during a period of very low flow conditions in late summer.

### 2.2.1.2 Survey for the 2012-2013 period

One scheduled freshwater biological survey was performed under very low recession flow conditions during the 2012-2013 monitoring period in late summer (February 2013). This survey was performed at the two established sites in the Kurapete Stream, one upstream and the other downstream of the confluence of the tributary with the Kurapete Stream (Table 5 and Figure 2).

**Table 5** Biomonitoring sites surveys

Site number	Site code	Map reference	Location
I	KRP000960	Q19: 207 304	Upstream of quarry tributary stream
J	KRP000980	Q19: 208 305	Everett Road bridge, d/s of tributary stream

The biomonitoring report, which illustrates the location of the sampling sites, is attached as Appendix II to this report. The results from this survey are summarised in Table 6 with the specific quarry monitoring historical data to date.

**Table 6** Summary of Inglewood Metal Ltd quarry biomonitoring results for the Kurapete Stream performed from March 1997 to February 2013

Site	Taxa numbers				MCI values		
	1996-2012			2012-13 result	1996-2012		2012-13 result
	No. of surveys	Range	Median	Feb 2013	Range	Median	Feb 2013
I	18	19-32	26	27	80-107	95	102
J	18	18-32	25	30	71-101	86	91
K	8	22-35	29	-	87-103	94	-

These results indicated no recent impacts on the faunal community over the short reach of the stream, below the small slightly turbid tributary draining the quarry area, downstream of the site and a short distance beyond the boundary of the permitted mixing zone. Minimal difference in faunal richnesses between these sites was found, despite some additional sedimentation in the reach of the lower Kurapete Stream below the quarry tributary inflow and minimal increase in visual turbidity of the main stream. There was a typical (small) downstream decrease in MCI score (reflecting subtle changes in community structure) coincident with some variability in physical habitat under a period of very low flow conditions preceding this survey. In general, these results reflected the recent trend of stream biota improvement recorded over most previous summers in the lower reach of the stream coincident with improved management and upgrades to the quarry wastewater treatment system and also following upstream water quality improvement subsequent to the diversion of the Inglewood oxidation ponds system wastes out of the stream in mid-catchment. Improvements in the configuration and operation of the quarry wastewater/stormwater settlement ponding system must be maintained in order to reduce the visual, aesthetic impacts of the often turbid quarry tributary receiving

waters on the main Kurapete Stream in the immediate vicinity of Everett Road. Relatively recent riparian vegetation planting in the proximity of the Everett Road site and fencing of the stream margins preventing stock access, should continue to enhance the stream habitat in this reach, particularly as the plantings have developed. Additional catchment riparian initiatives together with re-direction of dairy treatment ponds wastes to land disposal, could be anticipated to further enhance stream health in the longer term.

## **2.2 Investigations, interventions, and incidents**

The monitoring programme for the year was based on what was considered to be an appropriate level of monitoring, review of data, and liaison with the consent holder. During the year matters may arise which require additional activity by the Council eg provision of advice and information, or investigation of potential or actual courses of non-compliance or failure to maintain good practices. A pro-active approach that in the first instance avoids issues occurring is favoured.

The Taranaki Regional Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The Unauthorised Incident Register (UIR) includes events where the company concerned has itself notified the Council. The register contains details of any investigation and corrective action taken.

Complaints may be alleged to be associated with a particular site. If there is potentially an issue of legal liability, the Council must be able to prove by investigation that the identified company is indeed the source of the incident (or that the allegation cannot be proven).

In the 2012-2013 year, there were no incidents recorded by the Council that were associated with the consent holder.

## **2.3 Contingency plan**

An updated contingency plan was received from the consent holder in August 2006 for review by the Council, in compliance with Special Condition 14 of consent 1113. This contingency plan remains operative.

### **3. Discussion**

#### **3.1 Discussion of plant performance**

Management of the site during 2012-2013 generally was very good with no complaints received by the Council and no requirement for the issue of abatement notices by the inspecting officer in terms of the operational performance of the quarry. Additional retention within the quarry floor ponds and operation of a closed washwater re-circulation ponding system, continues to be necessary to provide compliance with treated wastewater standards. The requirement to maintain a closed washwater re-circulation system (separate from the quarry stormwater) has been re-emphasised with the new management. The provision of additional ponding within the quarry pit, presence of a silt trap and gravel filter to treat the stormwater from the area near the weighbridge, and de-silting of the treatment ponds, have been effective in achieving total compliance with appropriate resource consent conditions over the period. Further modifications to the treatment ponds may be necessary (particularly the correct configuration of the upper ponds system) as it has been recognised that greater retention in the groundwater/stormwater treatment pond system has the potential to improve treatment performance, particularly a reduction in the carry through of fine suspended sediment into the Kurapete Stream and re-suspension of fines in the tributary stream. In relation to this, fencing of the tributary stream below the quarry discharge, to prevent stock access to the tributary, was more recently undertaken by DOC, Taranaki Tree Trust, and Kaimata School. This fencing and planting of the tributary stream has prevented cattle disturbance of the stream bank and bed, allowing riparian benefits to occur and ultimately helping to stabilise and settle fine suspended solids. The performance of the system will continue to be monitored in this respect.

#### **3.2 Environmental effects of exercise of water permit**

The main potential environmental effect of quarrying activities on waterways is associated with discharges of washwater and stormwater containing fine silt particles and high suspended solids concentrations. Such discharges may result in discolouration of the receiving waters near the discharge point and smothering of benthic life forms, form a barrier to fish movement and/or affect fish spawning habitats. This is particularly relevant in the lower reaches of the Kurapete Stream near its confluence with the Manganui River.

The Taranaki Regional Council monitors for possible effects on stream biota and aesthetic quality by conducting a visual inspection of the stream both up and downstream of the quarry, and measuring physicochemical properties of the stormwater and receiving environment. Biological monitoring surveys have also been undertaken at established sites under low flow conditions to provide longer term indications of receiving water quality.

Monitoring of the quarry site during the 2012-2013 year has shown that the Inglewood Metal Ltd site has had minor impacts on the receiving waters of the Kurapete Stream, limited to occasional small increases in turbidity, particularly under low stream flow conditions. No significant effects were found by physicochemical monitoring of the receiving waters on each occasion during the period.

In addition, biological monitoring during a very low flow, late summer period found no localised impacts of quarrying activities on the biota of the Kurapete Stream coincidental with no change in visual turbidity in the lower reach of the stream.

On occasions in the past, a combination of very fine suspended sediment in the treated wastewater discharged, limited dilution by the receiving waters of the small tributary stream, and possibly some re-suspension of accumulated sediment previously deposited on the tributary stream bed, has contributed to cloudy (turbid) plumes entering the Kurapete Stream. Although increased retention of the wastewater by additional ponding in the quarry pit prior to discharge has been provided, appropriate isolation of the washwater recirculation (from the quarry pit wastewater inflow) must be maintained. More recent fencing and planting of the tributary's margins have also prevented cattle access which previously caused re-suspension of fine sediment. This may possibly allow aquatic vegetation to establish, providing filtration mechanisms and stabilisation of the silt laden bed, and reduce the effects of fine sediment plumes discharging to the Kurapete Stream.

It has been noted that the quarry stormwater catchment area (as authorised by Special Condition 3 of the consent) has expanded and may continue to expand, with the potential to overtax the settlement facilities due to increased volumes of stormwater/groundwater generated. Inflows of iron-laden groundwater seepages onto the quarry floor will continue to add to turbidity issues within the ponding system. This aspect of compliance has been assessed during the 2012-2013 period in conjunction with changes to the management of the settlement ponding facilities both on the floor of the quarry and associated with the washwater recirculation system and will continue to form a component of future monitoring activities.

### 3.3 Evaluation of performance

A tabular summary of the Company's compliance record for the year under review is set out in Table 7.

**Table 7** Summary of performance for consent 1113-4 for discharge of treated quarry groundwater, stormwater and washwater to a tributary of the Kurapete Stream

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Exercise methodology	Inspections of activities and treatment systems	Yes
2. Best practicable options to minimise effects	Liaison and inspections of treatment system and receiving waters	Yes
3. Limit to active quarry site	Inspections	Yes (marginal)
4. No direct discharges	Inspections	Yes
5. Washwater treatment and recirculation requirements	Inspections	Yes
6. Quarry site stormwater treatment provision	Inspections	Yes
7. Minimisation of silt discharged	Inspections and sampling surveys	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
8. Minimisation of exposed areas of quarry and reinstatement requirements	(to be addressed later in quarry life)	N/A
9. Silt control operation	Inspections and sampling surveys	Yes
10. Concentration limits on contaminants	Physicochemical sampling	Yes (on all occasions)
11. Limits on effects on receiving waters	Physicochemical and biological sampling	Yes
12. Limits on turbidity effects in receiving waters	Physicochemical sampling	Yes (on all occasions)
13. Reinstatement provision	Scheduled for consideration at end of active quarry life	N/A
14. Maintenance of contingency plan	Liaison with management (plan provided)	Yes
15. Optional review provision re environmental effects	No further reviews ex June 2012	N/A
Overall assessment of consent compliance and environmental performance		<b>High</b>

N/A = not applicable

During the year, Inglewood Metal Ltd demonstrated a high level of environmental performance and compliance with the resource consents at its Everett Road quarry site as issues relating to the operation of the wastewater treatment pond system and its configuration were given the necessary close attention coincident with an increase in size of the active quarry.

Fencing and planting of the DOC reserve on both banks of the Kurapete Stream downstream of the unnamed tributary and Everett Road (completed nine years previously), and along the right bank of the tributary stream (completed seven years previously), helped mitigate the effects on the Kurapete Stream and should continue to improve the aesthetic value of this reach of the lower stream.

### 3.4 Recommendations from the 2011-2012 Annual Report

As a result of the 2011-2012 site specific monitoring programme and in recognition of the compliance performance during the period, the following recommendations were made:

1. THAT monitoring of discharges from Inglewood Metal Ltd, Everett Road quarry in the 2012-2013 year continue at the same level as in 2011-2012.
2. THAT turbidity and sedimentation effects on receiving waters be minimised by operating and maintaining the sediment pond system in accordance with best quarry management practices.
3. THAT the consent holder and staff of the Regional Council liaise with respect to matters contained in Recommendation 2 (particularly when personnel changes occur amongst these officers).

4. THAT \$576 be credited to the consent holder in relation to the components of the 2011-2012 programme (wastewater and receiving water physicochemical sampling analyses) which were not performed due to either satisfactory plant performance or the non-exercise of the consent at the time of inspections.

The first recommendation was implemented and the monitoring programme was performed by the Taranaki Regional Council. In particular, the issues of turbidity and sedimentation effects on receiving waters had been addressed with management (recommendations 2 and 3) in relation to additional treatment ponds retention capacity and appropriate operation of the system in the 2008-2009 period when a meeting of TRC staff and the quarry manager was held to address these and other matters. The improved performance over the 2009-2012 and most recent period have reflected these initiatives. Riparian fencing and planting of the tributary stream, undertaken relatively recently, has continued to assist with mitigation of these effects. The appropriate credit was refunded to the consent holder as required by recommendation 4.

### **3.5 Alterations to the monitoring programme for 2013-2014**

In designing and implementing the monitoring programmes for water discharges in the region, the Taranaki Regional Council has taken into account the extent of information made available by previous authorities, its relevance under the Resource Management Act, the obligations of the Act in terms of monitoring discharges and effects, and subsequently reporting to the regional community, the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki discharging to the environment.

In recognition of the good management practices and compliance with resource consent conditions it is proposed that there be no change to the site-specific monitoring programme for the 2013-2014 period. A recommendation to this effect is attached to this report.

### **3.6 Exercise of optional review of consent**

Resource Consent 1113 does not provide for any further optional reviews of the consent prior to expiry in June 2015. In June, 2011 it was further noted that, although regular ongoing liaison with quarry management would be necessary to ensure that wastes treatment practices were attuned to the continuing expansion of this active quarry operation, it was not considered necessary to review the consent given that these matters could be considered comprehensively at the time of the expiry date (June, 2015) of the consent.



## 4. Recommendations

As a result of the 2012-2013 site specific monitoring programme and in recognition of the compliance performance during the period, the following recommendations are made:

1. THAT monitoring of discharges from the Inglewood Metal Ltd, Everett Road Quarry in the 2013-2014 year continues at the same level as in 2012-2013.
2. THAT turbidity and sedimentation effects on receiving waters be minimized by operating and maintaining the settlement ponds system in accordance with best quarry management practices.
3. THAT the consent holder and staff of the Regional Council continue to liaise with respect to matters contained in Recommendation 2 (particularly when personnel changes occur amongst these officers).
4. THAT \$408 be refunded to the consent holder in relation to the components of the 2012-2013 programme (wastewater and receiving water physicochemical sampling analyses) which were not performed due to either an assessment of satisfactory plant performance or the non-exercise of the consent at the time of inspections.

## 5. Acknowledgements

The Job Manager for the programme was Chris Fowles (Scientific Officer) who was the author of this Annual Report and also performed the macroinvertebrate survey. Field inspections and sampling surveys were undertaken by Samantha Bull (Investigating Officer) with physicochemical water and wastewater analyses performed by the Taranaki Regional Council ISO-9000 accredited laboratory.

## Glossary of common terms and abbreviations

The following abbreviations and terms are used within this report.

biomonitoring	assessing the health of the environment using aquatic organisms
bund	a wall around a structure to contain its contents in the case of leakage
Condy	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m
fresh	elevated flow in a stream, such as after heavy rainfall
g/m <sup>3</sup>	grammes per cubic metre, and equivalent to milligrammes per litre (mg/L). In water, this is also equivalent to parts per million (ppm)
incident	an event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred
intervention	action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring
investigation	action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident
l/s	litres per second
MCI	macroinvertebrate community index; a numerical indication of the state of biological life in a stream. It takes into account the sensitivity of the taxa present to organic pollution in stony habitats
mS/m	millisiemens per metre
mixing zone	the zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water
O&G	oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons)
pH	a numerical system for measuring acidity in solutions, with 7 as neutral. Values lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
physicochemical	measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment
resource consent	refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15)
RMA	Resource Management Act 1991 and subsequent amendments
SS	suspended solids,
Temp	temperature, measured in °C
Turb	turbidity, expressed in NTU
UI	Unauthorised Incident
UIR	Unauthorised Incident Register – contains a list of events recorded by the Council on the basis that they may have the potential or actual

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- Taranaki Regional Council 2012: 'Inglewood Metal Ltd Monitoring Programme Annual Report 2011-2012'. Technical Report 2012-10



## **Appendix I**

**Resource consent held by  
Inglewood Metal Ltd**



**Discharge Permit  
Pursuant to the Resource Management Act 1991  
a resource consent is hereby granted by the  
Taranaki Regional Council**

CHIEF EXECUTIVE  
PRIVATE BAG 713  
47 CLOTEN ROAD  
STRATFORD  
NEW ZEALAND  
PHONE 06-765 7127  
FAX 06-765 5097

Please quote our file number  
on all correspondence

Name of  
Consent Holder: Inglewood Metal Limited  
P O Box 44  
INGLEWOOD

Consent Granted  
Date: 20 May 2004

**Conditions of Consent**

Consent Granted: To discharge treated stormwater, treated groundwater and treated shingle washwater from quarry activities into an unnamed tributary of the Kurapete Stream a tributary of the Manganui River in the Waitara catchment at or about GR: Q19:206-299

Expiry Date: 1 June 2015

Review Date(s): June 2009, June 2012

Site Location: Everett Road, Inglewood

Legal Description: Pt Secs 15, 16 & 17 Blk XIII Waitara SD

Catchment: Waitara

Tributary: Manganui  
Kurapete

*For General, Standard and Special conditions  
pertaining to this consent please see reverse side of this document*

[www.trc.govt.nz](http://www.trc.govt.nz)

## Consent 1113-4

### General conditions

- a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.
- b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.
- c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:
  - i) the administration, monitoring and supervision of this consent; and
  - ii) charges authorised by regulations.

### Special conditions

1. The exercise of this consent shall be conducted in accordance with the information submitted in support of the application and to ensure that the conditions of this consent are met at all times.
2. At all times the consent holder shall adopt the best practicable option [as defined in Part 2 of the Act] to prevent or minimise any actual or likely adverse effect on the environment associated with the discharges including, but not limited to, the water quality and aquatic habitat of the receiving waters of the Kurapete Stream.
3. The active quarry stormwater catchment shall have a maximum area of no more than 2 hectares.
4. There shall be no direct discharge of untreated stormwater, groundwater or waste washwater from the active quarry site into the unnamed tributary of the Kurapete Stream as a result of the exercise of this consent.
5. The washing and washwater treatment system shall be bunded to prevent the inflow of stormwater and groundwater from other areas of the quarry. In addition the consent holder shall implement appropriate recirculatory systems so as to minimise the volume of washwater required to be discharged.
6. The active quarry site shall be contoured/bunded so that all water generated in this area is directed to silt retention systems for treatment prior to discharge, and to prevent the flow of uncontaminated stormwater into the quarry, as far as is practicable.
7. The consent holder shall undertake measures to minimise the amounts of silt and sediment that could be contained in the discharge licensed by this consent.
8. The consent holder shall operate and progressively reinstate the quarry in a manner that minimises the quarry stormwater catchment area and ensures that the area of exposed unvegetated earth within the quarry stormwater catchment is kept to a minimum at all times.
9. The consent holder shall properly and efficiently maintain and operate the silt control structures in such a manner that any discharge which may occur shall not breach the conditions of this consent. The silt control structures shall be operated, as far as practicable, so as to maximise the treatment of the stormwater and minimise the duration, frequency and rate of the discharge.

Consent 1113-4

10. The following concentrations shall not be exceeded in any discharge:

Component	Concentration
pH (range)	6-9
Suspended solids	100gm <sup>-3</sup>
Total recoverable hydrocarbons	15gm <sup>-3</sup>

This condition shall apply prior to the entry of any discharge into the receiving waters of the unnamed tributary of the Kurapete Stream, at a designated sampling point approved by the Chief Executive.

11. After allowing for reasonable mixing, within a mixing zone extending 25 metres downstream of the confluence of the unnamed tributary with the Kurapete Stream, the discharge shall not give rise to any of the following effects in the receiving waters of the Kurapete Stream:
- a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
  - b) any conspicuous change in the colour or visual clarity;
  - c) any emission of objectionable odour;
  - d) the rendering of fresh water unsuitable for consumption by farm animals;
  - e) any significant adverse effects on aquatic life.
12. After allowing for reasonable mixing, within a mixing zone extending 25 metres downstream of the confluence of the unnamed tributary with the Kurapete Stream, the discharge shall not give rise to either of the following effects in the receiving waters of the of the Kurapete Stream:
- a) an increase in suspended solids concentration in excess of 10 gm<sup>-3</sup>, when the stream turbidity as measured immediately upstream of the confluence of the unnamed tributary with the Kurapete Stream is equal to or less than 5 NTU [nephelometric turbidity units]; or
  - b) an increase in turbidity of more than 50% when the stream turbidity as measured immediately upstream of the confluence of the unnamed tributary with the Kurapete Stream is greater than 5 NTU [nephelometric turbidity units].
13. On cessation of quarrying operations at the site licensed by this consent, the active quarry area, including the silt control structures, and surrounding areas shall be reinstated satisfactorily, prior to the surrender or lapsing of this consent.
14. The consent holder shall maintain a contingency plan to the satisfaction of the Chief Executive, outlining measures and procedures to be undertaken to prevent the spillage or accidental discharge of contaminants in the stormwater catchment, and measures to avoid, remedy, or mitigate the environmental effects of such a spillage or discharge.
15. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2009 and/or June 2012, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 20 May 2004

For and on behalf of  
Taranaki Regional Council



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Director Resource Management





## **Appendix II**

### **Biomonitoring survey of February 2013**

**To** K Brodie, Environmental Monitoring Manager  
**From** CR Fowles, Scientific Officer  
**File** 1113  
**Document** 1184059  
**Report No** CF568  
**Date** 15 April 2013

## **Biomonitoring of the lower reaches of the Kurapete Stream, in relation to Inglewood Metal Ltd Quarry discharges, surveyed in February 2013**

### **General Introduction**

A formal consent monitoring programme established for Inglewood Metal Ltd, Everett Road in the lower Kurapete Stream catchment, has been the subject of seventeen TRC Annual Reports to date (eg: TRC, 2012). Various impacts of the consent holder's quarrying activities have been noted from a programme of regular inspections and physicochemical receiving water sampling. One of the recommendations of these reports required:

*"That monitoring be continued ..... with an appropriate programme formulated in accordance with the requirements of existing consents and taking into account matters addressed in these Annual Reports. This programme to include a limited summer biomonitoring survey undertaken at two sites in the lower reach of the Kurapete Stream (upstream and downstream of the confluence of the quarry tributary stream)."*

This requirement recognised the fisheries importance of the lower reaches of the Kurapete Stream and the need for a form of monitoring which provided longer-term indications of receiving water quality.

Therefore, late summer-autumn low flow biomonitoring surveys have been undertaken in the lower reaches of the Kurapete Stream situated upstream and downstream of the small tributary receiving quarry run-off and wastes discharges. In addition to these biomonitoring surveys, other surveys were performed in May 1997, in response to an unauthorised incident report (CF145), and in October 2002 (CF259), as a follow-up to the previous summer biomonitoring survey (March 2002) performed under low recession flow conditions in the lower reaches of the Kurapete Stream which indicated a significant impact on the faunal community of the stream below the small turbid tributary draining the quarry area.

In more recent years, confounding issues of upstream water quality improvement (due to removal of the Inglewood oxidation ponds effluent discharge from the Kurapete Stream (TRC, 2011a)), together with cattle access in the proximity of the Everett Road bridge site, necessitated the addition of a third monitoring site (KRP000983) some 150 m downstream of the bridge for effects assessment.

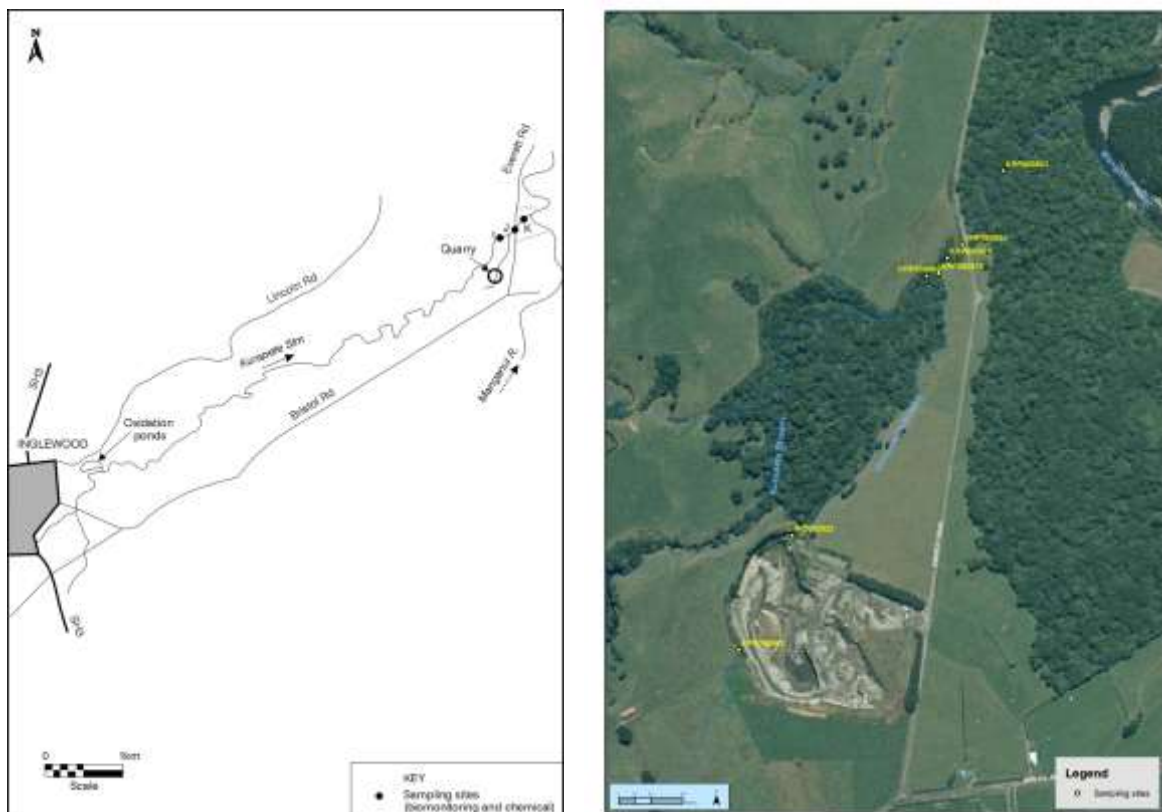
The current February 2013 survey continued the summer biomonitoring component of the formal consent monitoring programme but did not require the inclusion of this additional site following an inspection of the substrate and the acceptable aesthetic appearance of the Kurapete Stream downstream of the confluence with the tributary draining the quarry area.

## Method

The standard '400 ml kick sampling' technique was used to collect streambed (benthic) macroinvertebrates from the two established sites (I and J) in the lower reaches of the Kurapete Stream, near Everett Park on 1 February 2013 (Figure 1).

These sites were:

Site No	Site code	GPS Reference	Location
I	KRP000960	1710640E 5668709N	Upstream of quarry tributary stream
J	KRP000980	1710695E 5668758N	Everett Road bridge, d/s of tributary stream



**Figure 1** Sampling sites in the Kurapete Stream in relation to Inglewood Metals Ltd, quarry

This 'kick-sampling' technique is very similar to Protocol C1 (hard-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001).

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al, 2001). Macroinvertebrate taxa found in each sample were recorded as:

R (rare)	= less than 5 individuals;
C (common)	= 5-19 individuals;
A (abundant)	= 20-99 individuals;
VA (very abundant)	= 100-499 individuals;
XA (extremely abundant)	= 500 or more individuals.

Macroinvertebrate Community Index (MCI) values were calculated for taxa present at each site (Stark 1985) with certain taxa scores modified in accordance with Taranaki experience.

A semi-quantitative MCI value, SQMCI<sub>5</sub> (Stark, 1999) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling these scores, and dividing by the sum of the loading factors. The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA).

## Results and discussion

This late summer survey was performed under very low recession flow conditions, 18 days after a fresh in excess of three times median flow and 75 days since a fresh in excess of seven times median flow. Water temperatures were 17.5°C at both sites at the time of this mid morning survey.

The flow at both sites was very slightly cloudy in appearance with no apparent visual impact from the quarry tributary, which atypically was relatively clear and in very low flow at its confluence with the Kurapete Stream, downstream of the quarry ponds' treated wastewater discharge at the time of the survey. Site I was shaded, with thin periphyton mats, no filamentous algae, and patchy moss cover and leaf litter on the substrate. The more open site J, below the quarry tributary, had patchy moss and leaf litter, and widespread periphyton mats and filamentous algae covering the substrate which was firmer in composition than on all but the most previous occasion. The stream banks had been fenced adjacent to this site more than nine years previously to prevent stock access and riparian growth was extensive on both banks. Some additional silt was apparent at site J, trapped amongst the periphyton and deposited amongst components of the bed of the stream, and more abundant in slower flowing areas toward the stream's right bank at site J. Although significant improvements had been made to waste disposal practices at the quarry over the past sixteen years, fines from the settled quarry stormwater and groundwater discharge, have continued to enter the Kurapete Stream between sites I and J causing increased cloudiness at the downstream site (TRC, 2012) although as noted above, there was minimal increase in visual turbidity on this occasion. The more open stream margins in the short reach in the vicinity of site J contributed to the widespread growth of denser periphyton substrate cover on the bed of this reach of the stream, a consequence of upstream diffuse and point source nutrient inputs to this small narrow catchment.

## Macroinvertebrate communities

Biomonitoring of the impacts of quarrying activities on the Kurapete Stream has been performed previously on eighteen occasions and site I had been surveyed as a component of the Inglewood oxidation pond system monitoring programme between early 1989 and March 1993. A summary of all data for this site to date is provided in Table 1.

**Table 1** Summary of macroinvertebrate taxa numbers and MCI values for all previous surveys performed at site I (KRP000960), upstream of the quarry

No. of surveys	Taxa Numbers		MCI Values	
	Range	Median	Range	Median
27	12-32	23	70-107	89

A summary of comparative data for all three sites since quarry biomonitoring commenced is presented in Table 2. (Eight surveys have been performed at site K to date).

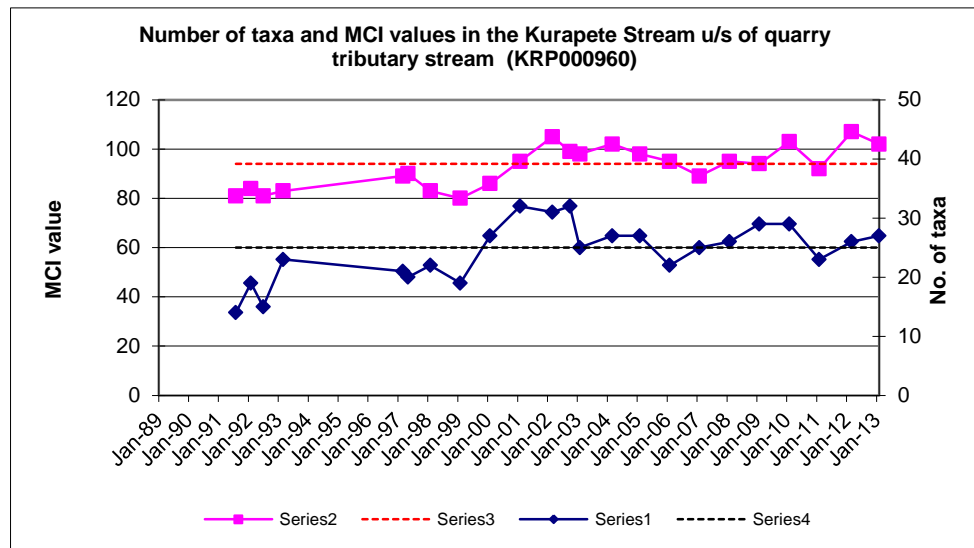
**Table 2** Summary of macroinvertebrate taxa numbers and MCI values for previous surveys performed between January 1997 and March 2012

Site	No. of surveys	Taxa Numbers		MCI Values	
		Range	Median	Range	Median
I	18	19-32	26	80-107	95
J	18	18-32	25	71-101	86
K	8	22-35	29	87-103	94

The results of the recent survey are presented in Table 3.

### Site I: upstream of quarry tributary

Historical data for this site are illustrated in Figure 2.



**Figure 2** Taxa richness and MCI scores recorded to date at site I

Taxa richness at site I was moderate (27 taxa) for the lower reaches of a small stony ringplain seepage stream rising outside of the National Park, receiving agricultural run-off and point source discharges. It was slightly better than the median richness recorded for this site to date (Table 1) and very similar to the median richness since the improvement recorded over the last thirteen years as a result of the removal of the municipal ponds' treated wastes discharge from the stream at Inglewood (Table 2 and Figure 2 and TRC, 2012a). The faunal community was dominated by one 'highly sensitive' taxon [extremely abundant mayfly (*Deleatidium*)]; four 'moderately sensitive' taxa [(mayfly (*Coloburiscus*), elmids beetles, dobsonfly (*Archichauliodes*), and crane fly (*Aphrophila*)]; and three 'tolerant' taxa [oligochaete worms, (snail (*Potamopyrgus*), and net-building caddisfly (*Aoteapsyche*)]; some of these taxa being typical of slightly enriched streams. The 'highly sensitive' mayfly taxon was particularly dominant under these very low flow conditions, and three other 'highly sensitive' taxa were recorded at this site. The MCI score (102) reflected the higher proportion of 'sensitive' taxa (63% of faunal richness) in the community. This score was a significant (Stark, 1998) 13 units above the median of all scores (Table 1) previously recorded at this site and was seven units above the median score (Table 2) recorded since quarry biomonitoring commenced. The current MCI score was six units higher than that predicted for a ringplain stream site at an altitude of 110m asl (Stark and Fowles, 2009). Taxa richness and MCI score

(Figure 2) continued to reflect the general improvement in stream conditions (physicochemical water quality and physical habitat) consistent with the cessation of the Inglewood oxidation ponds system's discharge (which has been diverted to the New Plymouth Wastewater Treatment Plant) and in the absence of any recent (consented) overflows from the system during wet weather periods (TRC, 2012a and Fowles, 2013).

**Table 3** Macroinvertebrate fauna of the Kurapete Stream in relation to Inglewood Metal Ltd's quarry discharge sampled on 1 February 2013

Taxa List	Site Number	MCI score	I	J
	Site Code		KRP000960	KRP000980
	Sample Number		FWB13030	FWB13031
COELENTERATA	Coelenterata	3	-	R
NEMERTEA	Nemertea	3	R	R
ANNELIDA (WORMS)	Oligochaeta	1	VA	VA
	Lumbricidae	5	R	-
MOLLUSCA	<i>Latia</i>	5	R	C
	<i>Potamopyrgus</i>	4	VA	A
	Sphaeriidae	3	-	R
CRUSTACEA	Ostracoda	1	-	R
EPHEMEROPTERA (MAYFLIES)	<i>Austroclima</i>	7	C	A
	<i>Coloburiscus</i>	7	A	A
	<i>Deleatidium</i>	8	XA	A
	<i>Ichthybotus</i>	8	R	-
	<i>Zephlebia group</i>	7	C	A
PLECOPTERA (STONEFLIES)	<i>Zelandobius</i>	5	R	R
	<i>Zelandoperla</i>	8	R	R
COLEOPTERA (BEETLES)	Elmidae	6	VA	VA
	Ptilodactylidae	8	R	R
MEGALOPTERA (DOBSONFLIES)	<i>Archichauliodes</i>	7	A	A
TRICHOPTERA (CADDISFLIES)	<i>Aoteapsyche</i>	4	VA	VA
	<i>Costachorema</i>	7	C	-
	<i>Hydrobiosis</i>	5	C	C
	<i>Neurochorema</i>	6	-	R
	<i>Oxyethira</i>	2	-	A
	<i>Pycnocentroides</i>	5	C	C
	<i>Tripletides</i>	5	R	R
DIPTERA (TRUE FLIES)	<i>Aphrophila</i>	5	VA	A
	<i>Maoridamesa</i>	3	-	R
	Orthoclaadiinae	2	R	A
	<i>Polypedilum</i>	3	R	C
	Tanytarsini	3	C	R
	Empididae	3	C	C
	<i>Austrosimulium</i>	3	C	C
	Tanyderidae	4	R	R
<b>No of taxa</b>			27	30
<b>MCI</b>			102	91
<b>SQMCI</b>			6.0	4.3
<b>EPT (taxa)</b>			12	11
<b>%EPT (taxa)</b>			44	37
<b>'Tolerant' taxa</b>		<b>'Moderately sensitive' taxa</b>	<b>'Highly sensitive' taxa</b>	

R = Rare    C = Common    A = Abundant    VA = Very Abundant    XA = Extremely Abundant

## Site J: Everett Road bridge (downstream of quarry tributary)

Historical data for this site are illustrated in Figure 3.

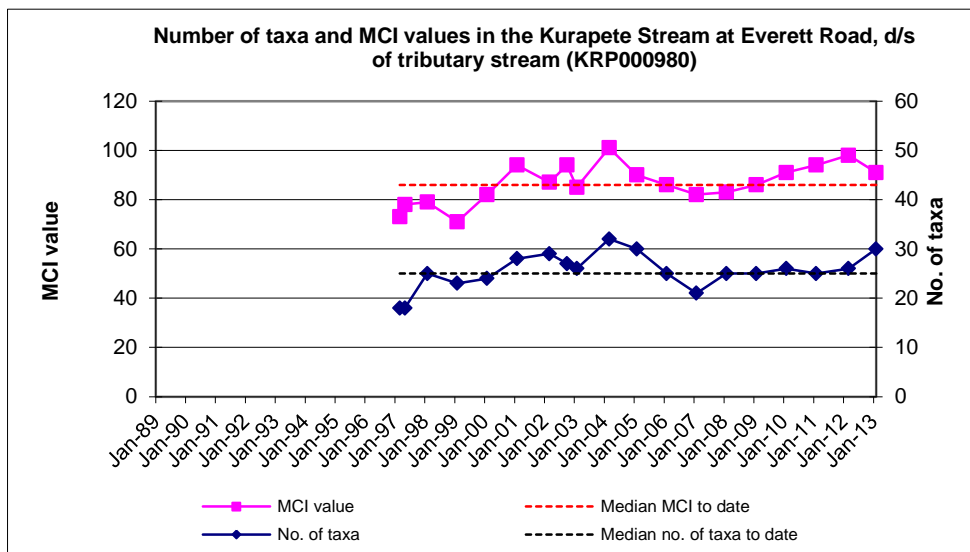


Figure 3 Taxa richness and MCI scores recorded to date at site J

A small downstream increase in taxa richness (30) was found at the more open site J, downstream of the quarry tributary where slightly siltier, looser substrate conditions were more characteristic of the streambed. Far more extensive periphyton substrate cover (particularly in the form of widespread mats and filamentous algae) was apparent on the finer sedimented, although firmer than usual, substrate. The dominant taxa included all of the 'sensitive' and 'tolerant' taxa which were abundant at the upstream site and an additional two 'moderately sensitive' [mayflies (*Austroclima* and *Zephlebia* group)] and two 'tolerant' [algal-piercing caddisfly (*Oxyethira*) and orthoclad midges] taxa coincident with the much more extensive periphyton substrate cover. There was a slight increase in the proportion of 'tolerant' taxa (50% of the total taxa) comprising the fauna at this downstream site. Slightly fewer 'highly sensitive' taxa were recorded although one of these was abundant but no longer extremely abundant.

Few significant community composition changes were recorded but the drop in numbers (from extremely abundant to abundant) within the 'highly sensitive' mayfly, *Deleatidium*, and increased abundances within two 'tolerant' taxa resulted in a decrease in SQMCI<sub>s</sub> score (by 1.7 units) when compared to the score obtained at the upstream site I. The MCI score at site J (91) decreased by a significant 11 units below the score at site I upstream mainly due to the absence of one 'highly sensitive' taxon recorded only as a rarity upstream and the presence of four additional 'tolerant' taxa (as rarities), rather than as the result of any significant changes in community composition. However, this score was five units higher than the median of scores recorded at this site to date (Figure 3). This difference between the two adjacent sites was statistically significant (Stark, 1998) coincident with the variability in habitat conditions (particularly periphyton substrate cover) between sites.

## Conclusions

This late summer biomonitoring survey was performed under a period of very low recession flow conditions in the lower reaches of the Kurapete Stream. The survey indicated relatively limited impacts on the faunal community over the short reach of the stream, attributable to



variability in habitat (rather than quarry discharge impacts) below the small tributary draining the quarry area, downstream at the site a short distance beyond the boundary of the permitted mixing zone. Some subtle differences in faunal richnesses between these sites were found, coincident with minor sedimentation in the reach of the lower Kurapete Stream below the quarry tributary inflow and minimal increase in visual turbidity of the main stream, as aesthetic conditions in the stream below the quarry tributary were better than usually recorded, at the time of the current survey. There was a typical, downstream decrease in MCI score (reflective of subtle changes in community structure) under a period of very low flow conditions preceding the survey, coincident with the physical habitat variability noted at this more open site. In general, these results reflected the recent trend of stream biota improvement recorded over most previous summers coincident with improved management and upgrades to the quarry wastewater treatment system and following upstream water quality improvement subsequent to the diversion of the Inglewood oxidation ponds system wastes out of the stream in mid-catchment. Improvements in the configuration and operation of the quarry wastewater/stormwater settlement ponding system must be maintained in order to reduce the visual, aesthetic impacts of the often turbid quarry tributary receiving waters on the main Kurapete Stream in the immediate vicinity of Everett Road. Relatively recent riparian vegetation planting in the proximity of the Everett Road site and fencing of the stream margins preventing stock access, has enhanced the stream habitat in this reach, particularly as the plantings have developed. However, further catchment riparian initiatives together with re-direction of dairy wastes disposal to land could be expected to further enhance stream health in the longer term.

## Summary

The Council's standard 'kick-sampling' technique was used at two established sites to collect streambed macroinvertebrates from an unnamed tributary of the Kurapete Stream. Samples were processed to provide number of taxa (richness), MCI score, SQMCI<sub>s</sub> score and %EPT taxa for each site.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The SQMCI<sub>s</sub> takes into account taxa abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities. It may also provide more relevant information than the MCI in relation to non-organic impacts. Differences in either the MCI or the SQMCI<sub>s</sub> between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

This late summer macroinvertebrate survey indicated that the discharge of treated quarry wastewaters from the Inglewood quarry site had minimal recent detrimental effects on the macroinvertebrate communities of the Kurapete Stream. While some changes in the macroinvertebrate communities were noted between the upstream 'control' site and the first site downstream of the discharge, beyond the designated 25 m mixing zone, despite no obvious increase in turbidity of the stream at the time of the survey, these were coincidental with some increase in sedimentation of the streambed but far more extensive periphyton substrate cover. These changes included some reduction in 'highly sensitive' mayfly numbers and an increase in characteristic 'tolerant' taxa which were coincidental with increased algal substrate cover at the downstream, more open site.

The macroinvertebrate communities of the Kurapete Stream contained relatively high proportions of 'sensitive' taxa at both sites and the communities were generally dominated

by a combination of 'moderately sensitive' and 'tolerant' taxa with a typical increase in the proportion of 'tolerant' taxa at the site downstream of the quarry discharge.

MCI scores indicated that the stream communities were of 'good' to 'fair' health at the two sites and were relatively typical of conditions recorded in similar Taranaki streams. The 'health' of this lower reach of the stream in general was typical of the trend of improvements in conditions recorded over recent years since the diversion of treated oxidation ponds wastes out of the mid catchment and improvements to quarry management practices. Longer term improvements could be anticipated as a consequence of future catchment wide riparian and dairy wastes land disposal initiatives.

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