REPORT

Irongate Industrial Plan Change
Stream Ecological Valuation Assessment

Prepared for Hastings District Council

NOVEMBER 2008

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QUALITY ASSURANCE STATEMENT

PROJECT MANAGER	REVIEWED BY
Tim Grace	David Cameron
PREPARED BY	**APPROVED FOR ISSUE BY**
Adam Forbes	Tim Grace

HAWKES BAY
1st Floor, 100 Warren Street South, PO Box 1190, Hastings 4156, New Zealand
P + 64-6-873 8900, F + 64-6-873 8901

REVISION SCHEDULE

Rev No	Date	Description	Prepared By	Reviewed By	Approved By

HASTINGS DISTRICT COUNCIL

Irongate Industrial Plan Change
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1 Introduction

MWH New Zealand Limited has been commissioned by the Hastings District Council to assist with the preparation of a change to the Hastings District Plan to rezone land in the vicinity of the Irongate Stream for industrial purposes. This land is currently zoned 'Plains' under the Hastings District Plan.

The area being considered for rezoning is located approximately 3 km southwest of Stortford Lodge, Hastings. The area is crossed in a general north-south orientation by the Irongate Stream. The alignment of the Irongate Stream in relation to the proposed plan change area is shown in Figure 1-1 below.

The Auckland Regional Council Stream Ecological Valuation method (SEV) (Rowe et al., 2008) has been applied at the Irongate Stream to (1) quantify the current integrity of associated aquatic ecological functions and (2) establish a benchmark measure of ecosystem function against which future land use changes can be measured.

The objectives of this report are:

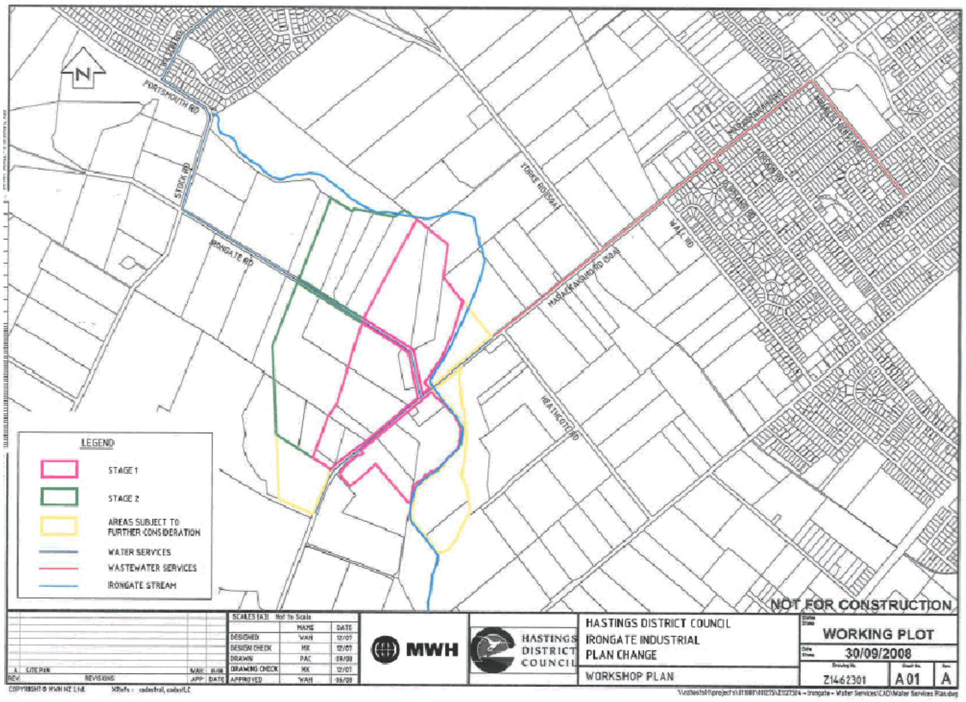
1. To document the assessment methods used in the SEV calculation to allow comparable SEV assessments to be made at the same site in the future.

2. To document and discuss the results of the SEV assessment in the context of the proposed rezoning of the land concerned for future industrial purposes..

The SEV assessment method focuses on measurement of hydraulic, biogeochemical, habitat provision and biotic ecological functions of a given stream reach. In this case the SEV investigation included a fish survey, a macroinvertebrate survey and a range of other measurements prescribed by the SEV method to quantify the integrity of ecological functions operating at the study site.

This report provides a description of the study site and the methods adopted for the study. The results of the SEV calculation are presented and discussed, and conclusions are made regarding the SEV results in the context of the rezoning proposal.

Figure 1-1 : Irongate Stream alignment (blue line) in relation to the area proposed for rezoning.



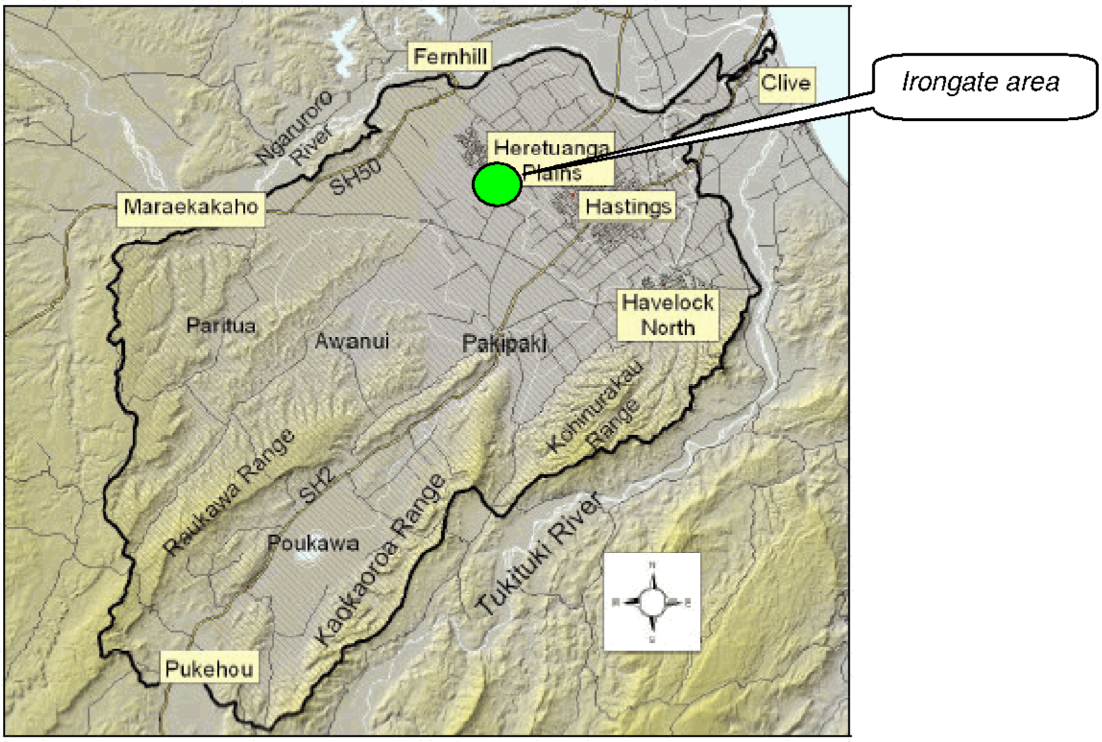
2 Site Description

2.1 Catchment considerations

2.1.1 Location of Irongate Stream within the Karamu catchment

The Irongate Stream is a tributary of the Karamu Stream. The Irongate Stream is positioned in the mid to lower reaches of the Karamu catchment. The approximate location of the relevant reach of the Irongate Stream in relation to the Karamu catchment is presented in Figure 2-1 below.

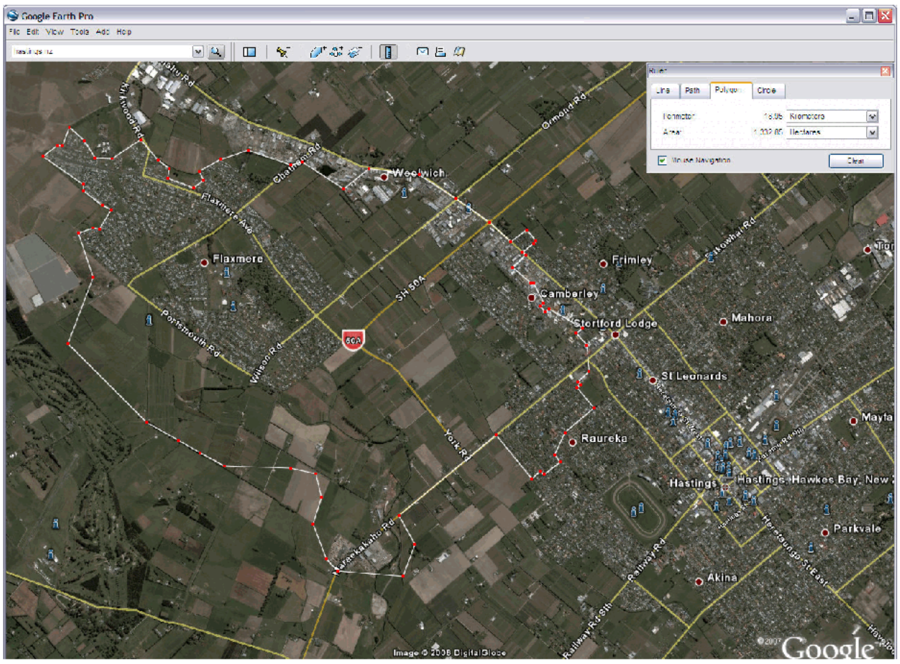
Figure 2-1 : Location of the Irongate Stream, at Irongate, in relation to the wider Karamu catchment.



- Figure 2-1 sourced from the *Te Karamu* report (HBRC, 2004).

The approximate Irongate Stream catchment boundary, upstream of the SEV study site, is presented in Figure 2-2 below.

Figure 2-2 : Approximate Irongate Stream catchment boundary (white line) above SEV study site



2.1.2 Land use

Land use in the Irongate Stream catchment comprises industrial use (i.e. existing industrial uses in the Irongate Road Maraekakaho Road area and existing industrial uses in the Omahu industrial zones), residential use (i.e. the suburbs of Flaxmere, Raureka and Camberley) and horticultural / agricultural uses (i.e. short rotation cropping, grazing, orcharding).

2.1.3 Impervious surface

The Irongate stream drains considerable areas of impervious surface occupied by residential and industrial land uses. The approximate percentage of the Irongate Stream covered with impervious surface is presented below.

Table 2-1 : Impervious surface within the Irongate catchment, above the SEV study site

Irongate Stream SEV - Impervious Surface Breakdown			
	Existing	Impervious	% of Catchment Impervious
	(ha)	(ha)	
Total catchment area above SEV site	1332.85		
Urban / Industrial areas	523.21	340.09	26
Non urban or industrial area	809.64	c. 4	<1

2.1.4 Topography

The Irongate area lays approximately 15 to 20 metres above sea level. The Irongate Stream flows across a section of the Heretaunga Plains, which is an alluvial landform primarily developed through deposition of river gravels. The local landform is a flat plain, draining generally to the east. The plain features small scale localised down-cutting, caused by fluvial erosion (stream channels), and a relict river bed (the former Ngaruroro River alignment).

2.2 Stream characteristics

2.2.1 Management regime

Historical management has resulted in extensive modification of the Irongate Stream. Today it continues to be held under a ‘flood control’ orientated management regime.

With the development of the suburb of Flaxmere in the 1960s, the Irongate Stream channel between Portsmouth Road and State Highway 2 was enlarged and straightened. Further channel upgrading was carried out in 2002. Clarke’s Weir (refer Figure 2-3 below) was installed in a position immediately upstream of the Upper Southland Drain outlet (HBRC, 2004).

Figure 2-3 : Clarke’s Weir.

It is understood that periodically, for drainage enhancement purposes, aquatic plants are mechanically removed from the stream bed. This activity would result in considerable disturbance to the aquatic environment.

2.2.2 Riparian conditions

Land development has heavily modified the riparian state of the Irongate Stream. With respect to vegetation cover, channel and floodplain morphology, and adjoining land use, the existing riparian conditions are very different from those conditions which would have occurred historically, under unmodified conditions.

Typically within 20 metres (laterally) of each side of the wetted stream channel, riparian vegetation is dominated by exotic grasses (refer Figure 2-4). Also present are occasional exotic trees and shrubs (refer Figure 2-5 below).

Figure 2-4 : Typical grazed or mown riparian margins

Figure 2-5 : One of the more vegetated riparian areas

Typically, adjacent industrial or horticultural / agricultural activities occur within the riparian zone (if defined as a zone of 20 metres either side of stream channel) (refer Figure 2-6 and Figure 2-7 below). Industrial and productive land uses have been measured to be currently operating as close as 6 metres to the wetted stream channel.

Figure 2-6 : Effluent dumping (white patches) within the riparian margin

Figure 2-7 : Timber processing within the riparian margin

The existing riparian zone typically provides little or no shading or overhead vegetation cover. Therefore the stream doesn't currently benefit from riparian associated processes which would normally enhance habitat and provide organic matter sources to the stream environment.

2.2.3 Channel form and substrate size

The Irongate Stream channel has been extensively 'channalised', both through straightening and through formation of uniform 'batter slopes'. Stream reaches are typically long and natural floodplains have been replaced with batter slopes. Some minor floodplain development (terracing) has occurred locally on the batter slope surfaces.

Some variation was noted between the channel form in areas upstream and down-stream of Clarke's Weir. Presumably this difference is the result of areas of the Irongate Stream being subjected to different degrees of anthropogenic channel modification, and the consequential effects of modification.

The stream typically has a mean depth of 0.5 metres and a mid stream depth of 0.9 metres. The wetted channel width is typically 5.6 metres.

Flow dynamics within the channel have a low diversity of variation (run – riffle – pool – shute, etc), with any variation largely caused by in-stream vegetation and by changes in the stream alignment.

The underlying stream bed is largely comprised of medium to large gravels (i.e. 16mm to 32mm). Large amounts of very fine sediment covers the majority of the stream bed, and commonly settles to cover aquatic plants. Deposition of very fine sediments up to a depth of 40cm is not uncommon at mid-channel. The rate of sediment deposition is likely to have been accelerated by removal of the forest cover and land use development.

2.2.4 Aquatic fauna

A recent fish survey associated with the SEV survey has confirmed previous data on fish species present within the Irongate Stream. The fish survey shows that Clarke's Weir presents a significant barrier to fish passage. Surveys upstream and downstream of the weir show considerable differences in the types of fish present (refer Table 2-2 below).

	Above Clarke's Weir				Below Clarke's Weir		
Common name	**Scientific Name**	**Abundance**	**Threat Category***	**Common name**	**Scientific Name**	**Abundance**	**Threat Category***
Native							
Shortfin eel	*Anguilla australis*	Abundant	Nil	Shortfin eel	*Anguilla australis*	Abundant	Nil
Koura	*Paranephrops planifrons*	Abundant	Nil	Longfin eel	*Anguilla dieffenbachii*	Rare	Chronically Threatened – Gradual Decline
				Inanga	*Galaxias maculatus*	Rare	Nil
				Common bully	*Gobiomorphus cotidianus*	Rare	Nil
Exotic							
Mosquito fish	*Gambusia affinis*	Common	Nil	Goldfish	*Carassius auratus*	Common	Nil
				Mosquito fish	*Gambusia affinis*	Abundant	Nil

Table 2-2 : Fish fauna recorded during the October 2008 survey.

Note: *Threat category follows that provided by (Hitchmough, Bull, & Cromarty, 2005).

The Irongate Stream has been measured to have a Macroinvertebrate Community Index (MCI) score of 42. This low score is expected to be influenced by the abundant soft substrate and sediment deposition, and rarity of hard substrate. Historical Hawke's Bay Regional Council macroinvertebrate monitoring has found the Irongate stream to have a mean MCI score of 65 (Stansfield, 2004).

2.2.5 Aquatic flora

Six exotic and one native macrophyte species have been observed in the Irongate Stream (Stansfield, 2004). The native species was duckweed (*Lemna minor*). The exotic species were fennel leaved pond weed (*Potamogeton pectinatus*), curled pond weed (*Potamogeton cripus*), elodea (*Elodea canadensis*), water celery (*Apium nodiflorum*), swamp willow weed (*Persicaria decipiens*), and water cress (*Nasturium officinale*).

2.2.6 Water quality

Nutrients
Water quality investigations carried out by HBRC (Stansfield, 2004) showed that in the context of the Karamu catchment, the Irongate Stream has low dissolved reactive phosphorous (DRP) and elevated soluble inorganic nitrogen (SIN) and ammonia concentrations.

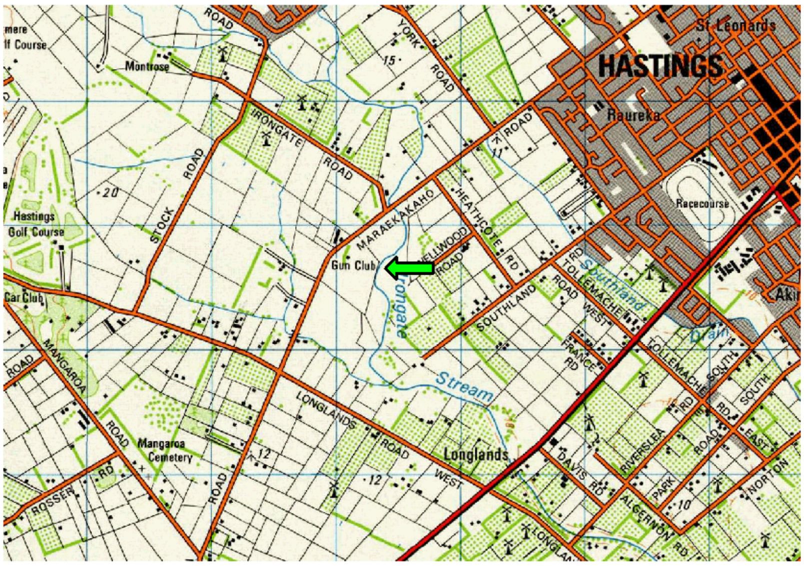
Physicochemical
Suspended sediment loads are reported (Stansfield, 2004) to be elevated downstream of the Upper Southland Drain stormwater outfall. Water temperatures and diurnal dissolved oxygen measurements indicate that these variables would not cause mortality of fish or macroinvertebrates living in the stream (Stansfield, 2004).

2.3 SEV study site

2.3.1 Location

The location of the 2008 SEV assessment is shown in Figure 2-8 below. The study site was selected as it is representative of conditions within and surrounding the Irongate Stream, within the reach which passes through the proposed plan change area. It is located downstream of the existing industrial uses and is also within the downstream extent of the proposed plan change area. It is also likely that the future industrial zoning would be established on both banks of the stream at the study site. On this basis the location of the survey site is considered to be indicative of actual and potential influences by land use adjacent to the Irongate Stream, within the proposed plan change area.

Figure 2-8 : SEV study site location (green arrow).



The study reach is 100 metres long and can be located using the GPS coordinates presented below:

- 0 metres – upstream - start: NZMG E2836366 N6165714 (+/-5 metres).
- 100 metres – downstream - finish: NZMG E2836322 N6165626 (+/-5 metres).

The location of the SEV assessment site is shown in Figure 2-9 and Figure 2-10 below.

Figure 2-9 : SEV assessment reach at 0 metres

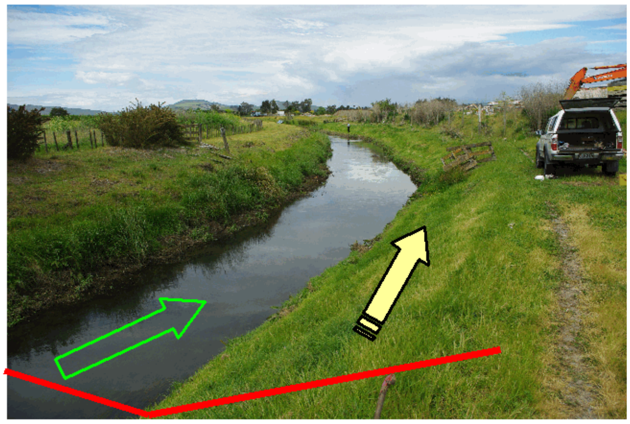
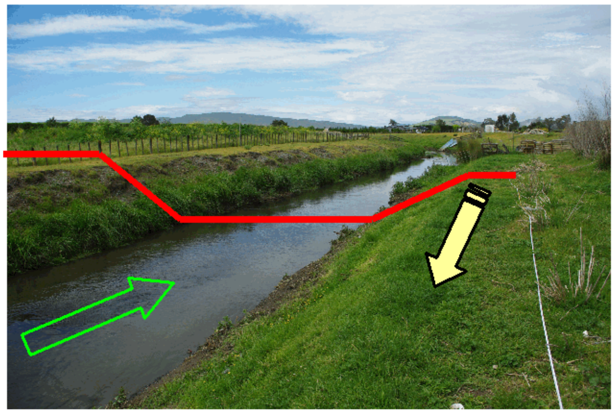


Figure 2-10 : SEV assessment reach at 100 metres



Note: = indicates SEV study area. = indicates direction of stream flow.

3 Methods

3.1 Reference site rationale

In the context of the SEV method, a reference site should be un-impacted by development or other human disturbance. A reference stream should be of a similar stream order, underlying geology, gradient and substrate type, and should have an intact native forest riparian zone. Such conditions represent the original or 'best case' scenario.

Due to the highly modified nature of riparian conditions associated with lowland streams on the Heretaunga Plains, no pristine reference site is available for inclusion in the SEV calculation. NIWA have provided an opinion that Auckland reference stream data can be applied to urban streams in Hawke's Bay[1]. Since a pristine spring feed lowland stream is not available as a reference site, reference conditions have been assembled using relevant information contained in the NIWA / HBRC derived Hawke's Bay Reference data set, Auckland Regional Council reference data, reference data collected from the Wellington Region, and data based on expert opinion of what original conditions would have been at the study site.

It is known that during pre-polynesian times (i.e. more than 800yrs BP) Hawke's Bay was covered in woody vegetation (Fromont & Walls, 1988). Further, charred wood fragments have been found in the banks of the Irongate Stream (Grant, 1996) and at other locations on the Heretaunga Plains, which, along with other forest remains, suggest that the area would once have supported a tall native forest community. On this basis it is assumed that before human settlement, the Irongate Stream would have benefited from a riparian zone with full native forest cover. This assumption has consequently been adopted in the compilation of the reference SEV data.

The study reach of the Irongate Stream has a gravel substrate underlying the fine sands, silts, and clays which currently dominate the substrate. The assumption has been made that the abundance of fine sediments which currently dominate are largely the result of relatively recent catchment land use and drainage modification. It is expected that a cover of native vegetation would have stabilised much of the sediment which is currently discharge to the Irongate Stream. On this basis, the substrate size distribution assumed for the reference data set is dominated by medium to large sized gravels and large gravels, with a more minor component (yet still present) being comprised of sands, silts and clays.

As it is potentially problematic to determine accurately what macroinvertebrate community structure would have been present in reference conditions, macroinvertebrate data from the Auckland reference site, the Nukumea Stream (Albany), has been adopted. This is a hard-bottom stream which has a naturally low MCI and EPT score, which is also a characteristic expected to be attributed to the Irongate Stream.

In the absence of knowledge of historical fish fauna community structure, the Irongate 'reference' Index of Biotic Integrity (IBI) score has been matched to the IBI score calculated for the study site.

3.2 SEV Methods

3.2.1 Field surveys

Fish fauna

A fish survey was carried out by Massey University (Palmerston North) on Wednesday the 15th of October 2008. The survey comprised backpack electro-fishing, three Fyke traps set for one night, and a spotlight survey after dark. The survey covered areas of the Irongate Stream upstream and downstream of the State Highway 2 Road crossing, and on private land above Clarke's Weir.

[1] This confirmation has been provided in the letter dated 22nd May 2008 from Stephanie Parkyn (NIWA) to Graham Sevicke-Jones (HBRC) (attached as Appendix A).

Macroinvertebrate fauna

A macroinvertebrate survey was carried out on the 21st October 2008, in accordance with the soft bottomed, semi-quantitative sampling protocol provided in the MfE protocols for sampling macroinvertebrates in wadeable streams (Stark, Boothroyd, Harding, Maxted, & Scarsbrook, 2001). Macrophyte and bank margin vegetation were the key macroinvertebrate habitats targeted for sampling.

Macroinvertebrate identification was carried out by Landcare Research.

SEV assessment

The SEV assessment was carried out using the standard field sheets and in accordance with the standard method as outlined in TP302 (Rowe et al., 2008). No deviations from the standard method were made. Cross sectional components of the method were undertaken at 10 metre intervals, beginning at and working downstream from, NZMG E2836366 N6165714.

3.2.2 Desktop analyses

Impervious surface and flood detention structures

The catchment area and percentage impervious surface cover within the catchment upstream of the study site were measured from aerial photographs using the Google Earth Professional area calculation function. In order to determine percentage impervious surface, the assumption was made that urban and industrial areas have an average impervious cover of 65% of their total extent. One flood detention pond, the Kaiapo Dam, is located in the Upper Southland Drain (HBRC, 2004), which forms part of the Irongate Stream catchment.

3.3 Limitations

No actual reference site is available on the Heretaunga Plains for the Irongate SEV. On this basis the previous NIWA / HBRC reference data, Auckland reference data (Nukumea Stream, Albany) and reference data collected by the Author from the Wellington Region and from the Author's experience and opinion were relied upon to compile representative reference scores.

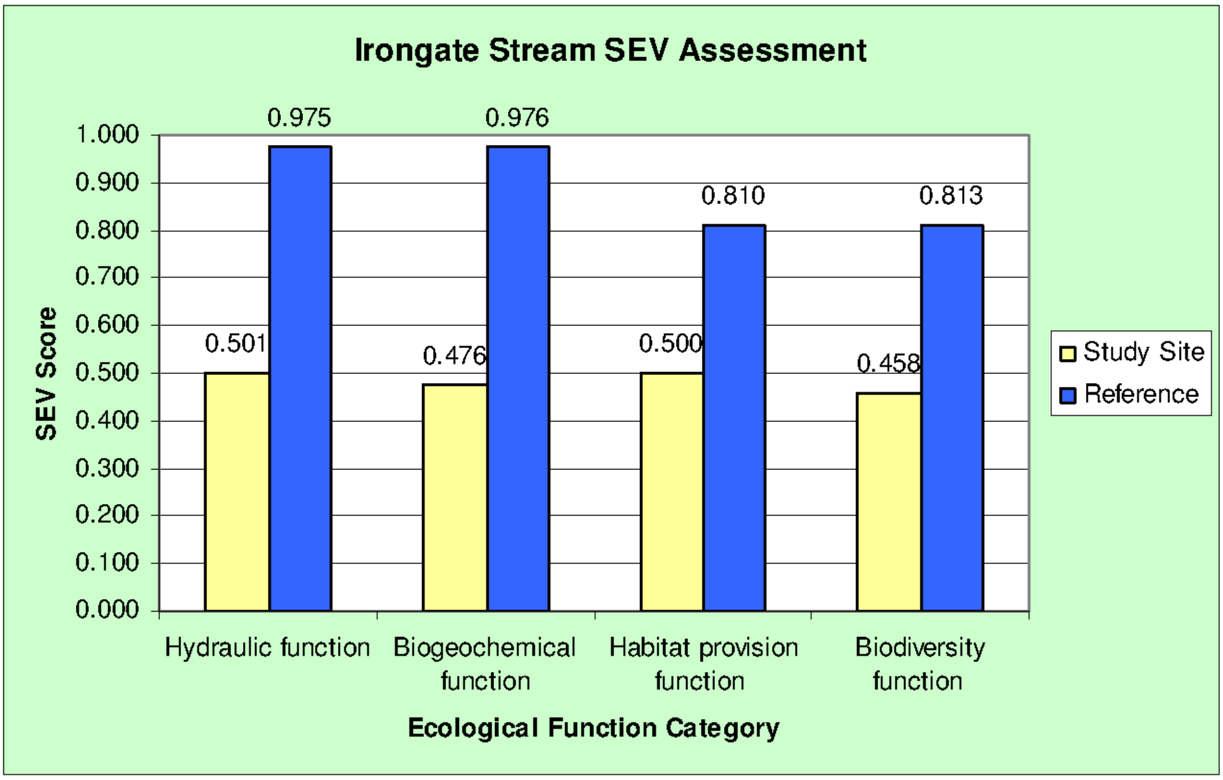
4 Results

4.1 Function scores

Overall the integrity of ecological functions associated with the study site of the Irongate Stream scored a mean function score of 0.481. The reference scenario scored a mean function score of 0.914.

A comparison of mean SEV function scores against mean reference scores is provided in Figure 4-1 below.

Figure 4-1 : Comparison of mean SEV function scores between the study site and reference data.



A breakdown showing individual SEV variable scores and the contribution variable scores make to the function scores is presented in Table 4-1 below.

Table 4-1 : Results of Irongate Stream SEV calculation.

Category	Function		Variable	Irongate	Reference
Hydraulic			Vbed	0.64	1.00
			Verosn	1.00	1.00
			Vimper	0.20	1.00
	NFR	**=**		0.16	1.00
			Vfpwidth	0.00	1.00
			Vfreq	0.40	0.80
	CFP	**=**		0.20	0.90
			Vbarr	1.00	1.00
			Vcatch	1.00	1.00
	CSM	**=**		1.00	1.00
			Vbed	0.64	1.00
	CGW	**=**		0.64	1.00
	Hydraulic function mean score			**0.50**	**0.98**
Biogeochemical			Vshade	0.02	1.00
			Vdepth	1.00	1.00
			Vveloc	0.60	0.60
			Vlength	0.80	1.00
	WTC	**=**		0.41	0.93
			Vdod	0.60	1.00
	DOM	**=**		0.60	1.00
			Vcanop	0.00	1.00
			Vdecid	0.00	0.00
	OMI	**=**		0.00	1.00
			Vtrans	1.00	1.00
			Vretain	0.58	1.00
	IPR	**=**		0.58	1.00
			Vsurf	1.00	0.99
	DOP	**=**		1.00	0.99
			Vfpwidth	0.00	1.00
			Vrough	0.40	1.00
			Vfreq	0.40	0.80
	FPR	**=**		0.27	0.93
	Biogeochemical function mean score			**0.48**	**0.98**
Habitat provision			Vgalspwn	0.25	0.25
			Vgalqual	0.75	1.00
			Vgobspwn	0.80	1.00
	FSH	**=**		0.49	0.63
			Vphyshab	0.87	1.00
			Vwatqual	0.07	1.00
			Vimper	0.20	1.00
	HAF	**=**		0.50	1.00
	Habitat provision function mean score			**0.50**	**0.81**

Continued over page…

Biodiversity			Vfish	0.50	0.50
	FFI	**=**		0.50	0.50
			Vmci	0.00	1.00
			Vept	0.75	1.00
	IFI	**=**		0.38	1.00
			Vvert	0.50	0.50
			Vinvert	0.67	1.00
	ABI	**=**		0.58	0.75
			Vripcond	0.10	1.00
			Vripconn	1.00	1.00
			Vripar	0.03	1.00
	RVI	**=**		0.38	1.00
	Biodiversity function mean score			**0.46**	**0.81**
Sum of scores				7.69	14.63
Overall mean SEV scores				**0.481**	**0.914**

Field results sheets are provided as Appendix B. A CD containing an electronic copy of the SEV calculation is attached to the back cover of this report.

Fish survey data is attached as Appendix C.

5 Discussion

5.1 Impervious surface

More than 25% of the catchment area upstream of the SEV study site is covered in impervious surface. On this basis, while flow data is not available to confirm, it is expected that the natural flow regime of the Irongate Stream has been altered by stormwater runoff. It is however considered that given the consistent groundwater contributions received by the Irongate Stream, the lower base flows normally associated with catchments containing high percentages of impervious surface may not occur in the Irongate Stream near Irongate Road and Maraekakaho Road. Analysis of flow data would be required to confirm the flow variability of the Irongate Stream.

Under the SEV scoring regime, the study site of the Irongate Stream scores very poorly (i.e. only 0.20) due to the impacts on the ecological integrity by the high proportion of impervious surface. The score reflects the likely impact the high proportion of impervious surface would have on water quality and flow variability.

The plan change process could address this issue to a degree by promoting measures to minimise the future affect of increased impervious surface on the Irongate Stream. Stormwater overland runoff would be a key pathway for transport of suspended sediment and other contaminants from surrounding future land use activities to the Irongate Stream. The plan change process provides for opportunities to ensure that stormwater impacts on the Irongate Stream associated with land use change are appropriately managed.

5.2 Channel modification

Channel modification has resulted in removal of the natural floodplains (i.e. floodplains which are formed in a morphological balance with the stream hydraulics) and have created more homogeneous flow conditions (i.e. reduction in the diversity of hydraulic features such as riffle, pool, eddy, and chutes features, etc).

The removal of natural floodplains have impaired the streams natural ability to accommodate flood flows, and to maintain favorable in-stream flow conditions (i.e. velocities) during higher flows. The homogenisation of flow conditions has also impaired habitat values associated with the study site.

The artificially uniform channel conditions, in conjunction with the apparently abundant sediment supply, are likely to be contributing to the adverse accumulation of very fine sediments. A diversity of velocity conditions are more likely to make areas of the stream bed more resistant to sediment deposition.

The uniform channel characteristics have reduced the ability of the stream to retain beneficial leaf litter and other organic debris for decomposition and biological assimilation.

The low roughness of floodplain vegetation resulted in a low SEV score (i.e. 0.40).

Naturalisation of the stream channel would assist in addressing this issue.

5.3 Riparian condition

The highly modified and degraded riparian zone is significantly impairing a range of ecological functions. Such aspects affected by the absence of quality riparian vegetation include:

- Reduced organic energy supply – organic matter inputs from vegetation within the riparian zone (allochthonous inputs) to the in-stream environment;

- Reduced shading – increased light radiation to the water surface and through the water column, which potentially affects dissolved oxygen, pH, photosynthesis and respiration, water temperature, and macroinvertebrate community structure;
- Reduced floodplain roughness – slowing the release of floodwaters to maintain a more natural flow regime;
- Buffering of the aquatic environment - buffering of water quality values from the potential influences of surrounding land use activities, such as discharges of dust, stormwater, litter and other discharges.

The existing riparian conditions scored very poorly under the SEV assessment framework with a score of 0.02 being returned for shading, 0.10 for riparian condition, and 0.03 for riparian area.

Enhancement of the riparian zone would provide a buffer for the Irongate Stream from the potential adverse influences associated with adjacent land use.

5.4 Sediment deposition

Fine sediment is being supplied to the Irongate Stream at a higher rate than it can be dispersed, resulting in deposition. The rate of sediment deposition is likely to have been accelerated by removal of the forest cover and agricultural development. The ability of the gravel benthic environment to support complex and diverse biological communities has been impaired by extensive deposition of fine sediments. The promotion of measures to minimise the potential for further entrainment of sediments from surrounding land use to the Irongate Stream would assist in addressing this issue.

5.5 Habitat and biodiversity functions

The high percentage of impervious surface within the catchment upstream of the site, as well as the sparse to absent beneficial riparian vegetation substantially reduce habitat and biodiversity values for the study site.

The native fish community comprises common bully, inanga, longfin and shortfin eels. All of these fish species are diadromous, migrating to the sea to fulfil their life cycle requirements (McDowall, 2000). Common bully and inanga are known to be naturally found in declining abundances with increasing distance from the sea, and are typically only found short distances upstream from the sea (Harding, Mosley, Pearson, & Sorrell, 2004). In contrast longfin eels are commonly found both in lowland streams and for considerable distances inland.

The SEV study site, while still a low altitude lowland stream, is located 28km upstream from the sea. On this basis, common bully and inanga would be naturally less abundant at the study site and the importance of potential spawning habitat for these two species should be given less weight than for sites located in close proximity to the sea. The IBI has a biogeographical aspect and considers how geographical location affects fish distributions.

Inanga spawning habitat (i.e. low level riparian vegetation on low gradient terraces) at the study site is scarce, and where present is of a medium quality. Common bully spawning habitat (i.e. large hard substrates) is present, but is largely smothered under abundant fine sediment deposition. It can be summarised that while spawning habitats for these two species are generally poor, the importance of these areas for provision of spawning habitats is somewhat limited by the distance of the site from the sea. In particular I wouldn't expect to find any inanga spawning in this part of the Irongate Stream.

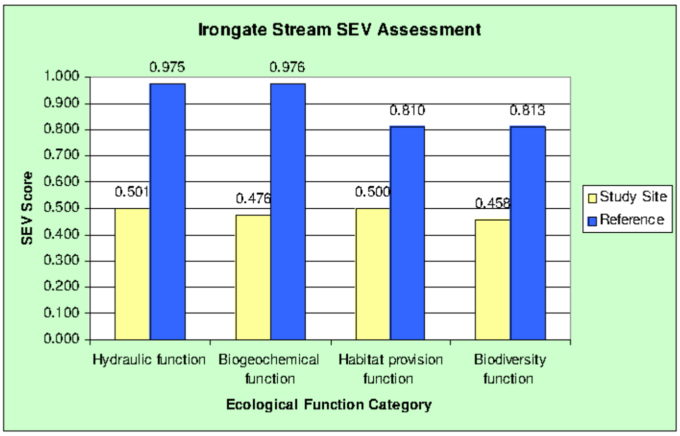
In classifying the biological integrity of the fish community at the site, the IBI accounts for the influence of the site's biogeographical location. The site scores an IBI of 30 (pers comms Dr M Joy, October 2008) (of a maximum possible IBI score of 60) which classifies the fish fauna assemblage as being of 'medium quality' (Joy & Death, 2004).

Macroinvertebrate community index scores are consistently low within the Irongate Stream. As well as being an indication of organic enrichment, the low scores are likely to be a reflection of the physical conditions present. In particular, the slow and homogeneous flow patterns, deep water, lack of shading and corresponding water temperature fluctuations, low macroinvertebrate habitat availability (dominance by soft unstable habitat opportunities) and heavy sediment deposition. The low MCI result required the lowest possible SEV variable score of 0.00.

6 Conclusions

The following conclusions are drawn from the results of the SEV assessment of the Irongate Stream:

1. The Irongate Stream scored a moderate (Authors classification) SEV score, being 0.481 compared to a mean reference score of 0.914. The mean hydraulic, biogeochemical, habitat provision and biodiversity function scores, relative to what original scores would have been at the Irongate Stream, are presented below:



2. The Irongate Stream channel has been heavily modified through channelisation and flood-control orientated management. These modifications are contributing substantially to the impairment of a range of natural functions, including hydraulic performance, biogeochemical processes, habitat quality and quantity, and the integrity of the biological assemblages.

3. More than 25% of the catchment area upstream of the SEV study site is covered in impervious surface. This is expected to some degree to have altered the natural flow variability and aquatic habitat functions such as water quality (in particular abundant fine sediment deposition) and hydraulic diversity of the Irongate Stream.

4. The riparian zone is heavily modified and degraded from what would have been its original state. The denuded condition of the riparian zone is significantly impacting the integrity of ecological functions operating at the site, most notably through lack of shading (and associated ecological responses), lack of organic matter inputs, lack of habitat for macroinvertebrates and fish cover, and low floodplain roughness. The existing riparian conditions also currently provide only minimal buffering of the stream environment from adjacent land use.

5. With regard to fish fauna, the site scores an IBI of 30, which according to the IBI classification system (Joy & Death, 2004) assigns the fish fauna assemblage a “medium quality” classification. The MCI scores are low, which is considered to be influenced by not only organic enrichment, but also physical conditions which dominate aspects of the site’s macroinvertebrate community structure and broader ecology.

6. When compared to original conditions, the integrity of ecological functions operating at the site are clearly substantially impaired. However, the plan change process can provide for opportunities to protect, and enhance the remaining values.

References

Fromont, M., & Walls, G. (1988). *The Lowlands of Hawke's Bay: Protected Natural Areas Programme Stage One Survey - Maungaharuru, Heretaunga and Eastern Hawke's Bay Ecological Districts.* Napier: Department of Conservation.

Grant, P. (1996). *Hawke's Bay Forests of Yesterday.* Waipukurau: Patrick J. Grant.

Harding, J., Mosley, P., Pearson, C., & Sorrell, B. (2004). Freshwaters of New Zealand. In. Christchurch: New Zealand Hydrological Society INC; New Zealand Limnological Society INC.

HBRC. (2004). Te Karamu: catchment review and options for enhancement. Unpublished Technical Report. Hawke's Bay Regional Council.

Hitchmough, R., Bull, L., & Cromarty, P. (2005). *New Zealand Threat Classification System Lists.* Wellington: Department of Conservation.

Joy, M., & Death, R. (2004). Application of the Index of Biotic Integrity Methodology to New Zealand Freshwater Fish Communities. *Environmental Management., 34*(3), 415 - 428.

McDowall, R. (2000). *The Reed Field Guide to New Zealand Freshwater Fishes.* Auckland: Reed Publishing.

Rowe, D., Collier, K., Hatton, C., Joy, M., Maxted, J., Moore, S., et al. (2008). *Stream Ecological Valuation (SEV): a method for scoring the ecological performance of Auckland streams and for quantifying environmental compensation - 2nd Edition.*: Auckland Regional Council.

Stansfield, B. (2004). *Aquatic Ecology and Water Quality: Karamu Stream.* Napier: Hawke's Bay Regional Council.

Stark, J. D., Boothroyd, I. K. G., Harding, J. S., Maxted, J. R., & Scarsbrook, M. R. (2001). *Protocols for sampling macroinvertebrates in wadeable streams New Zealand Macroinvertebrate Working Group report No.1*: Prepared for the Ministry for the Environment.

Acknowledgements

Thank you to Hawke's Bay Regional Council staff, Fiona Cameron and Sandy Heidekker with their assistance with the SEV field assessment work. The fish survey was undertaken by Dr Mike Joy and Amber McEwan of Massey University Palmerston North. Macroinvertebrate identification was undertaken by Stephen Moore of Landcare Research.

Appendix A : NIWA Correspondence on Hawke's Bay Reference Data

Taihoro Nukurangi

22 May 2008

Graham Sevicke-Jones
Hawke's Bay Regional Council
Private Bag 6006
Napier

Dear Graham

Modification of the SEV method for Hawkes Bay Streams

This letter is to confirm that we consider that the Stream Ecological Valuation (SEV) method developed for Auckland streams can be applied and used for the purposes of site comparison and evaluation of restoration potential in the Hawkes Bay urban streams.

A site visit was conducted on 10 January 2008 by myself and Dr Richard Storey with HBRC staff to assess stream types. Many of the streams were found to be slow flowing, soft bottomed streams not too dissimilar to the Auckland streams and the range of riparian conditions were thought to be covered by the SEV methodology. Initial concerns were raised about the effect of downstream pump stations, width of streams (generally wider than the Auckland streams) and the lack of reference sites that the SEV method relies on for comparison.

We subsequently held a workshop (10-11 April 2008; Dr Steph Parkyn, Dr Richard Storey, Dr Mike Joy) to describe the method to HBRC staff that would enable them to be able to use the method themselves, and also for them to raise any concerns about how the method would apply to Hawkes Bay. The workshop involved a mixture of theory and field investigation and two reaches of the same stream were surveyed by the participants. Data was inputted into pre-prepared spreadsheets that calculate scores for each of the 16 functions covered by the SEV methodology and algorithms.

The method requires reference stream reaches in native forest to compare the current reach functions against the original or best case scenario. There were no suitable reference sites in the Hawkes Bay. This required us to try a novel approach of a thought experiment based on the combined experience of the workshop participants on the functions of a pristine Hawkes Bay lowland stream. The reference site scores were similar to those of actual measured reference sites in the Auckland region (Table 1) that gave us confidence to use it in the spreadsheet calculations to produce the overall score for the test site.

We conducted a further thought experiment, where we predicted the best management outcomes possible for the test stream. This was based on riparian management at the stream reach that would likely be a mix of dense plantings near the stream edge (e.g. flax, cabbage tree in c.10m zone) with walkways and some larger trees and grassed areas away from the riparian zone. It was not thought that there would be much improvement in the catchment upstream due to the urban nature of the catchment. Table 2 lists the scores for each of the functions of the hypothetical post-restoration site alongside the scores of the test site.

National Institute of Water & Atmospheric Research Ltd
Gate 10, Silverdale Road, Hamilton
P O Box 11115, Hamilton, New Zealand
Phone +64-7-856 7026, Fax +64-7-856 0151

Table 1: Comparison of the hypothetical reference lowland Hawkes Bay stream with the means of three Papakura and three Albany reference streams in Auckland (refer to Rowe et al. 2008 for definition of variable codes).

Variable (code)	Function	Hypothetical Reference	Mean values for Papakura reference sites	Mean values for Albany reference sites
Vbed		1.00	0.93	1.00
Verosn		1.00	1.00	1.00
Vimper		1.00	0.90	1.00
=	**NFR**	**1.00**	**0.87**	**1.00**
Vfpwidth		1.00	0.60	1.00
Vfreq		0.80	0.53	0.81
=	**CFP**	**0.90**	**0.57**	**0.91**
Vbarr		1.00	1.00	1.00
Vcatch		1.00	1.00	1.00
=	**CSM**	**1.00**	**1.00**	**1.00**
Vbed		1.00	0.93	1.00
=	CGW	**1.00**	0.93	**1.00**
Hydraulic function mean score		**0.98**	**0.84**	**0.98**
Vshade		0.85	0.87	0.75
Vdepth		0.80	0.73	0.73
Vveloc		1.00	0.83	0.90
Vlength		0.40	1.00	1.00
=	**WTC**	**0.79**	**0.86**	**0.82**
Vdod		1.00	1.00	1.00
=	DOM	**1.00**	**1.00**	**1.00**
Vcanop		0.60	0.83	0.75
Vdecid		0.00	0.00	0.00
=	**OMI**	**0.60**	0.83	**0.75**
Vtrans		0.70	1.00	1.00
Vretain		1.00	0.98	0.88
=	IPR	**0.70**	**0.98**	**0.88**
Vsurf		1.00	0.95	0.97
=	**DOP**	**1.00**	**0.95**	**0.97**
Vfpwidth		1.00	0.60	1.00
Vrough		1.00	0.86	0.90
Vfreq		0.80	0.67	0.81
=	**FPR**	**0.93**	**0.71**	**0.90**
Biogeochemical function mean score		**0.84**	**0.89**	**0.89**
Vgalspwn		1.00	1.00	1.00
Vgalqual		1.00	0.58	1.00
Vgobspwn		1.00	1.00	1.00
=	**FSH**	**1.00**	**0.79**	**1.00**
Vphyshab		1.00	1.00	0.86
Vwatqual		0.92	0.94	0.88
Vimper		1.00		1.00
=	**HAF**	**0.98**	**0.96**	**0.90**

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Habitat provision function mean score		0.99	0.88	0.95
Vfish		0.97	0.95	0.98
=	FFI	**0.97**	**0.95**	**0.98**
Vmci		0.30	1.00	0.99
Vept		1.00	1.00	0.92
=	IFI	**0.65**	**1.00**	**0.95**
Vvert		0.97	0.95	1.00
Vinvert		1.00	1.00	1.00
=	ABI	**0.98**	**0.98**	**1.00**
Vripcond		1.00	1.00	1.00
Vripconn		1.00	1.00	1.00
Vripar		1.00	1.00	1.00
=	RVI	**1.00**	**1.00**	**1.00**
Biodiversity function mean score		0.90	0.98	0.98
Sum of scores (maximum value 16)		**14.50**	**14.38**	**15.06**
Overall mean SEV score (maximum value 1)		**0.907**	**0.90**	**0.94**

Table 2: Scores for the test site currently and after hypothetical restoration (refer to Rowe et al. 2008 for definition of variable codes)

Variable (code)	Function	George Stm – Test site	George Stm – hypothethical post-restoration
Vbed		0.70	0.70
Verosn		1.00	1.00
Vimper		0.20	0.20
=	NFR	**0.17**	**0.17**
Vfpwidth		0.70	0.70
Vfreq		0.40	0.80
=	CFP	**0.55**	**0.75**
Vbarr		1.00	1.00
Vcatch		1.00	1.00
=	CSM	**1.00**	**1.00**
Vbed		0.70	0.70
=	CGW	**0.70**	**0.70**
Hydraulic function mean score		**0.61**	**0.66**
Vshade		0.07	0.64
Vdepth		0.80	0.80
Vveloc		1.00	1.00
Vlength		0.40	0.40
=	WTC	**0.40**	**0.69**
Vdod		0.11	0.23
=	DOM	**0.11**	**0.23**
Vcanop		0.33	0.33
Vdecid		0.33	0.33
=	OMI	**0.28**	**0.28**

Vtrans		0.10	0.70
Vretain		1.00	0.86
=	IPR	**0.10**	**0.60**
Vsurf		0.90	1.00
=	DOP	**0.90**	**1.00**
Vfpwidth		0.70	0.70
Vrough		0.10	1.00
Vfreq		0.40	0.80
=	FPR	**0.40**	**0.83**
Biogeochemical function mean score		**0.37**	**0.61**
Vgalspwn		1.00	1.00
Vgalqual		0.25	1.00
Vgobspwn		0.10	1.00
=	FSH	**0.18**	**1.00**
Vphyshab		0.21	0.86
Vwatqual		0.06	0.19
Vimper		0.20	0.20
=	HAF	**0.17**	**0.53**
Habitat provision function mean score		**0.17**	**0.76**
Vfish		0.23	0.50
=	FFI	**0.23**	**0.50**
Vmci		0.00	0.30
Vept		0.00	1.00
=	IFI	**0.00**	**0.65**
Vvert		0.23	0.50
Vinvert		0.00	1.00
=	ABI	**0.12**	**0.75**
Vripcond		0.10	0.60
Vripconn		1.00	1.00
Vripar		0.00	0.50
=	RVI	**0.37**	**0.70**
Biodiversity function mean score		**0.18**	**0.65**
Sum of scores (maximum value 16)		**5.68**	**10.38**
Overall mean SEV score (maximum value 1)		**0.355**	**0.648**

The George stream test site scored particularly low for habitat provision (0.17), biodiversity (0.18) and biogeochemical functions (0.37). Our thought-experiment of applying riparian management to the system improved each of these functions greatly, particularly the habitat provision function. The hydraulic functions remained largely the same as there would be little change in the flow regime or catchment management upstream. The method can be applied in this way for a range of sites assessing their current functional value and the outcomes of improved management to prioritise sites for restoration. The SEV method only considers ecological improvements, so aesthetics, public amenity or economic matters are not included in this method. These factors can be considered separately, however, and combined into a final assessment of restoration priority. We showed an example of where this has been done in Papakura District.

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A few concerns were raised about situations where springs feed the streams, keeping them cooler than streams that are not spring fed, and how the method deals with that situation. It is important to remember that the method is an assessment of a stream reach in providing aquatic functions, so even though the stream water may be cool coming into the reach, the SEV method still assesses how well the stream reach functions to maintain the coolness. It is not an assessment of stream state, and is specific to the stream reach where the survey is carried out. The method does not include measures of bird or terrestrial biodiversity, and only includes riparian vegetation assessments as they pertain to stream health.

In conclusion, the workshop and investigation of stream sites confirmed that the range of measurements included in the SEV would be relevant to cover the range of conditions found in Hawkes Bay streams. A separate fish IBI to be produced by Dr Mike Joy will provide specific detail on the regional fish communities and this will be forwarded to you.

Yours sincerely

Stephanie Parkyn

www.niwa.co.nz
National Institute of Water & Atmospheric Research Ltd
Gate 10, Silverdale Road, Hamilton
P O Box 11115, Hamilton, New Zealand
Phone +64-7-856 7026, Fax +64-7-856 0151

Appendix B : Field Result Sheets

SEV (Stream Ecological Valuation) field sheet

Sheet 1 of 1

Page 1

Check Sheet

Stream Name	Irongate Stream
Site Code	Study
Date	21/10/2008
Project #	Z1462302

Project task	Tick when completed
Macroinvertebrates surveyed (do first)	Y
Fish surveyed (do second)	Y
Site description sheet completed	Y
Visual assessment sheets (3) completed	Y
Cross section sheets (2) completed	Y
Other components assessment sheet completed	Y
Instream Retention datasheet completed	Y
Habitat Assessment datasheet completed	Y
Substrate Assessment datasheet completed	Y
Photos taken	Y

SEV (Stream Ecological Valuation) field sheet

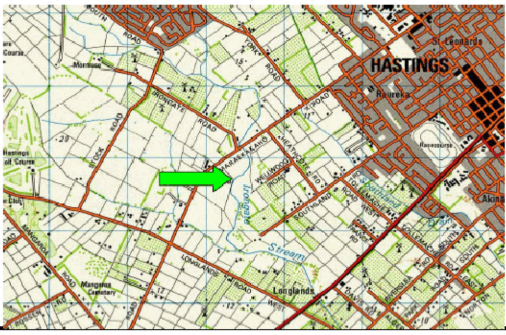
Sheet 1 of 1 **Page 2**

These field sheets have been designed to guide the collection of data suitable for assessment of stream reaches using the Stream Ecological Valuation technique (Rowe et al, 2006).
A separate set of field sheets should be completed for each site. Where deviation from the listed method is used please provide details in comments section

Site description

Date	21/10/2008	Team	MWH / HBRC	Current (tick)	
Stream Name	Irongate Stream	Weather conditions	Clear/sunny	Y	Has there been heavy rain in the past week (circle)?
Site Code	Study		Cloudy		Yes ✓
Site location	Behind gun club		Rain		No
GPS coordinates	Easting	2836366			
	Northing	6165714	Photo nos	-	

Site location map



Comments

SEV (Stream Ecological Valuation) field sheet

Sheet 1 of 3 **Page 3**

Visual assessment component - assess over entire reach length

Stream Name	Irongate
Site Code	Study
Date	21/10/2008

Ecological Function	Variable	Variable description	Criteria	Data to record (shaded areas)
Natural flow (NFR)	1. Vbed	Extent of channel bed modification	Channel type	Proportion of channel affected (0 - 1)
		See Figure p15 of SEV report for examples	Natural channel bed with no modification	0
			Natural channel bed but with some unnatural fine sediment loading	0.7
			Channelised with some or no modification (eg gabions)	0.3
			Channelised with total modification (eg concrete lining)	0

Natural flow (NFR)	2. Verosn	Proportion of bank length affected by flood flows resulting in erosion (circle appropriate range)	<5% ✓
			6-30%
			31-60%
			61-100%

Connectivity to flood plain (CFP)	3. Vfreq	Estimate of mean annual frequency of flooding	Estimated annual frequency of flood-plain inundation (circle appropriate value)
		If no data available, estimate using informed judgement. Need to take into account position in catchment, bank height and channel dimensions, presence of debris and/or sediment of floodplain, wet soils, degree of upstream imperviousness, presence of detention ponds, extent of channelisation. Consultation with locals may be useful.	Rare (<1/yr)
			Occasional (1-2/yr) ✓
			Often (3-5/yr)
			Frequent (>5/yr)

Connectivity for species migrations (CSM)	4. Vbarr	Identify natural and artificial barriers	Barrier types (# in reach)	Barriers present (circle appropriate category)
		See Figure p21 of SEV report for examples		None ✓
				Partial
				Total

SEV (Stream Ecological Valuation) field sheet

Sheet 2 of 3

Visual assessment component - assess over entire reach length

Stream Name	Irongate
Site Code	Study
Date	21/10/2008

			Indicators of oxygen reducing processes	Status of stream substrate (circle appropriate category)
Dissolved oxygen demand (DOM)	5. Vdod	Score DOD as per descriptors in next column	much black anaerobic sediment extensive sediment bubbling when disturbed sulphide odour when disturbed surface scums present abundant sewage fungus	Poor
			small patches of anaerobic sediment some sediment bubbling and sulphide odour when disturbed abundant macrophyte biomass some sewage fungus may be present	Marginal ✔
			no anaerobic sediment no sediment bubbling or sulphide odour moderate macrophyte biomass	Sub-optimal
			no anaerobic sediment no bubbling or odours little or no macrophyte biomass	Optimal

Flood-plain particle retention (FPR)	6. Vrough	Measures the thickness of vegetation on the floodplain	Proportion of banks covered by any of the following individual or combined vegetation types:			
		Refer to Figure p 33 of SEV report for examples	Bare, short grass (grazed, mown)	Sedges & long grass	Flax, shrubs, thick under-storey	Trees & thin under-storey
			0.5	0.5	0	0

Habitat for aquatic fauna (HAF)	7. Vphyshab	Provides an assessment of instream habitat quality	Complete 'Habitat Assessment Datasheet

			Extent of stream upstream of the reach being assessed that is shaded	Tick appropriate category
Habitat for aquatic fauna (HAF)	8. Vwatqual	Provides an assessment of the extent of shading upstream of the reach. Can estimate this using topographic maps as well as site visit	Well shaded (i.e. >50% of entire stream above site is forested)	
			Partially shaded (i.e. <50% of stream above site is forested)	
			Minimal shade (e.g. mainly pasture, but some riparian cover	✔
			No shade (mainly open pasture)	

SEV (Stream Ecological Valuation) field sheet

Sheet 3 of 3

Visual assessment component - assess over entire reach length

Stream Name	Irongate
Site Code	Study
Date	21/10/2008

Fish spawning habitat (FSH)	9. Vgalspwn	This provides a measure of area of available spawning habitat for galaxiids	Length of spawning habitat (m)
		Measure the length of near-flat (slope<10°) that would be inundated by floods or high tides. Measure entire bank edge length. Do for entire reach.	2m

			Quality of spawning habitat (circle appropriate category)
Fish spawning habitat (FSH)	10. Vgalqual	This provides a measure of the quality of spawning habitat for galaxiids. Assess the quality of spawning habitat for galaxiids in terms of substrate vegetation among which eggs are deposited. Refer to Figure p36 of SEV report for examples.	High
			Medium ✔
			Low

			Status of riparian vegetation	Tick appropriate category
Riparian vegetation intact (RVI)	11. Vripcond	Assesses the current condition of riparian vegetation within the stream reach	Mature indigenous vegetation, regeneration, diverse canopy and under-storey	
			intact mature canopy but damaged under-storey	
			regenerating bush (e.g. manuka scrub), low diversity, early stage in climax, protected	
			as for above but unprotected (e.g. cattle grazing in understorey)	
			occasional native trees present, non-native trees	
			areas of disturbed soils common (e.g. from animal pugging, herbicide use, cultivation in riparian areas)	
			grazed/short grass	✔
			long grass	

Riparian vegetation intact (RVI)	12. Vripconn	Assesses the connection between riparian trees and streams	Proportion of stream channel with linkages intact (0-1)
		Determine the proportion of stream channel where the connection(s) between riparian trees and the stream channel (eg. Root linkages) are NOT prevented by culverts, concrete linings, gabions, fences etc	1

Riparian vegetation intact (RVI)	13. Vripar	Assesses the intactness of the riparian zone	Proportion of intact riparian zone (0-1)
		Measure the proportion of riparian buffer zone (defined as 10m on either side of the stream) that is covered by trees or bush. Measure as horizontal distance from stream.	0.025

SEV (Stream Ecological Valuation) field sheet

Sheet 1 of 2

Cross section component - assess at each of 10 representative cross-sections along reach

Stream Name	Irongate
Site Code	Study
Date	21/10/2008

Ecological Function	Variable	Variable description	Criteria	Data to record (shaded areas)	
			Cross-section #	Floodplain width (m) (A)	Wetted channel width (m) (B)
Connectivity to flood plain (CFP)	14. Vfpwidth	Floodplain width compared to wetted channel width (floodplain extent defined by annual flood level)	1	3.8	4.7
			2	4.22	4.78
			3	4.32	6.18
			4	5.09	4.91
			5	3.76	5.44
			6	3.45	6.25
			7	3.71	6.19
			8	3.65	6.15
			9	2.98	6.11
			10	4.14	6.15
			Mean	3.913	5.686

Ecological Function	Variable	Variable description	Cross-section #	% of channel width/depth (m) 0	25	50	75	100
Water temperature control (WTC)	15. Vdepth	Measure depth at selected positions across channel. Water temperature control within a reach may be influenced by water depth, water velocity and the area of stream exposed to both solar radiation and ambient air temperature	1	0.07	0.5	0.77	0.8	0.13
			2	0.03	0.6	0.84	0.7	0.03
			3	0.09	0.5	0.68	0.63	0.15
			4	0.04	0.49	0.8	0.94	0.01
			5	0.05	0.65	0.97	0.8	0.2
			6	0.1	0.75	1.2	1.03	0.13
			7	0.03	0.75	1.18	0.96	0.02
			8	0.02	0.63	0.74	1.09	0.03
			9	0.02	0.68	1.11	0.82	0.04
			10	0.01	0.63	0.89	0.7	0.03
			Mean	0.046	0.618	0.918	0.846	0.077

Ecological Function	Variable	Variable description	Data to record
Determination of pollutants (DOP)	16. Vsurf	Assess bio-surface type and proportional cover. Measure the proportions of biosurface categories for each cross section. Record at same time as substrate assessment	Complete Substrate Assessment Sheet
Fish spawning habitat (FSH)	17. Vgobspwn	Assesses the amount of available spawning habitat for bullies. Measure the proportions of hard substrate categories (excluding bedrock) for each cross section, as well as medium to large woody debris	Complete Substrate Assessment Sheet

SEV (Stream Ecological Valuation) field sheet

Sheet 2 of 2

Cross section component - assess at each of 10 representative cross-sections along reach

Stream Name	Irongate
Site Code	Study
Date	21/10/2008

Ecological Function	Variable	Variable description	Cross-section #	Shaded proportion (A) (0 - 1)
Water temperature control (WTC)	18. Vshade	Proportion of stream channel shaded by vegetation, topographic features and artifical structures. Assess the proportion of shading that the stream surface is subject to. For example, zero shading would be a flat plain. Assume trees in full leaf (mid-summer conditions). Refer to Figure p25 of SEV report for examples	1	0.1
			2	0.1
			3	0
			4	0
			5	0
			6	0
			7	0
			8	0
			9	0
			10	0
			Mean	0.02

Ecological Function	Variable	Variable description	Cross-section #	Proportion of stream reach directly covered with overhead vegetation (0 - 1)
Organic matter input (OMI)	19. Vcanop	Measures the amount of leaf fall likely to be contributed from overhead vegetation.	1	0
			2	0
			3	0
			4	0
			5	0
			6	0
			7	0
			8	0
			9	0
			10	0
			Mean	0

Ecological Function	Variable	Variable description	Cross-section #	Proportion of canopy cover over stream that is deciduous (0-1)
Organic matter input (OMI)	20. Vdecid	Records whether or not overhead vegetation contributes leaf fall year round or only part of the year	1	0
			2	0
			3	0
			4	0
			5	0
			6	0
			7	0
			8	0
			9	0
			10	0
			Mean	0

SEV (Stream Ecological Valuation) field sheet

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Other components

Stream Name	Irongate
Site Code	Study
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Water temperature control (WTC)	21. Vlength	**Measure length of reach** Standardise survey reach length among sites, if appropriate	**Reach length (m) (L)** 100	
Water temperature control (WTC)	22. Vveloc	**Calculate mean velocity (Sm)** Take gauging at 1 point	**Velocity (m/s)** 1.026	
Instream particle retention (IPR)	23. Vtrans 24. Vretain	**This measure provides an assessment of the capacity of the stream reach to retain material**	**Complete Instream Retention Datasheet**	
Invertebrate fauna intact (IFI)	25. Vmci	**Provides a species list and community composition of macroinvertebrate fauna**	**Hard (HB) or soft (SB) bottomed sampling protocol applied?**	
	26. Vept 27. Vinvert	Sample using ARC protocols for hard and soft-bottomed streams, as appropriate. 1 composite sample per site to be collected.	SB	
Fish fauna intact (FFI)	28. Vfish	**Measures the species diversity of fish within the reach**	**Fish species present (list)**	
	29. Vvert	Electrofish with a single pass along the entire length of the stream reach. Also note any other vertebrates or large invertebrates.	Note Appendix C of report	

SEV (Stream Ecological Valuation) field sheet

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23 and 24 Instream Retention Datasheet

Stream Name	Irongate
Site Code	Study
Date	21/10/2008

This needs to be undertaken at 2 sections (runs) within the reach, starting with an upper section and then working downstream. The value is obtained by a: running a measuring tape from top to bottom of the reach section, b: releasing 20 painted plastic paper triangles into the stream at the top of the reach section and 3: recording the distance downstream each triangle travels within the reach section, as well as the structure(s) they are retained on.

Run 1

Distance (m)	# of triangles retained	Structure retained on (choose from list below)
1	2	AP
2	2	AP
2.5	1	AP
5	4	AP
21	1	AP
30	1	AP

Run 2

Distance (m)	# of triangles retained	Structure retained on (choose from list below)
2.5	3	AP
3	3	AP
3.5	3	AP
4	2	AP
4.5	1	AP
5	3	AP
27	1	AP

Structures retaining leaves							
Boulders and cobbles	Large wood and tree roots	Rooted aquatic plants/	Periphyton and leaf litter	Small wood	Bankside vegetation	Non-natural debris	Pool
B	LW	AP	PERI	SW	VEGE	NON	PL

SEV (Stream Ecological Valuation) field sheet

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16 and 17 Habitat Assessment Datasheet

Stream Name	Irongate
Site Code	Study
Date	21/10/2008

These data combined provide an assessment of instream habitat quality. For each habitat parameter, determine the most appropriate condition category for the survey reach, based on the descriptions provide. Within the selected condition category, circle the value which best describes the relative condition.

Habitat Parameter	Condition Category (circle most relevant value within range for category): Optimal	Suboptimal	Marginal	Poor
1. Aquatic Habitat Abundance - proportion of stream channel occupied by sutable habitat fesatures for instream fauna	> 50% of channel favourable for epifaunal colonisation and fish cover; includes woody debris, undercut banks, root mats, rooted aquatic vegetation, cobble or other stable habitat. Also includes macrophyte dominated streams.	30-50% of channel contains stable habitat.	10-30% of channel contains stable habitat.	< 10% of channel contains stable habitat. Note: Algae does not constitute stable habitat.
	20 19 18 17 **16**	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Aquatic Habitat Diversity	Wide variety of stable aquatic habitat types present including: woody debris, riffles, undercut banks, root mats, rooted aquatic vegetation, cobble or other stable habitat.	Moderate variety of habitat types; 3-4 habitats present including woody debris.	Habitat diversity limited to 1-2 types; woody debris rare or may be smothered by sediment.	Stable habitats lacking or limited to macrophytes (a few macrophyte species scores lower than several).
	20 19 18 17 16	15 14 13 12 11	**10** 9 8 7 6	5 4 3 2 1 0
3. Hydrologic Heterogeneity	Mixture of hydrologic conditions i.e. pool, riffle, run, chute, waterfalls; variety of pool sizes and depths.	Moderate variety of hydrologic conditions; deep and shallow pools present (pool size relative to size of stream).	Limited variety of hydrologic conditions; deep pools absent (pool size relative to size of stream).	Uniform hydrologic conditions; uniform depth and velocity; pools absent (includes uniformly deep streams).
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 **3** 2 1 0
	Optimal	Suboptimal	Marginal	Poor
6. Channel Shade	>80% of water surface shaded. Full canopy.	60 - 80% of water surface shaded; mostly shaded with open patches.	20 - 60% of water surface shaded; mostly open with shaded patches.	<20% of water surface shaded. Fully open; lack of canopy cover.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 **0**
7.Riparian Vegetation Integrity (within 20 meters)	No direct human activity in the last 30 years; mature native tree canopy and intact native understory	Minimal human activity; mature native tree canopy or native scrub; understory shows some impact (e.g. weeds, feral animal grazing).	Extensive human activity affecting canopy and understory; trees exotic (pine, willow, poplar); understory native or exotic.	Extensive human activity; little or no canopy; managed vegetation (e.g. livestock grazing, mowed); permanent structures may be present (e.g. building, roads, carparks).
Left bank	10 9	8 7 6	5 4 3	2 1 **0**
Right bank	10 9	8 7 6	5 4 3	2 1 **0**

SEV (Stream Ecological Valuation) field sheet

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Substrate Assessment Datasheet

Stream Name	Irongate
Site Code	Study
Date	21/10/2008

This assessment addresses spawning habitat for gobies, as well as providing data for assessment of the decontamination capacity of the stream reach based on organic material. The aim is to determine the relative proportion of different substrates and organic material within the reach. This can be acheived either through a broad-scale reach assessment (where diversity of types is low) or by detailed cross-section information(where diversity is of types is high). Where cross-sections are surveyed, divide the stream into 10 equally spaced points. At each point record the predominant substrate categories immediately in front of the mid-line of your boot or similar (1 = present). At the same point also record the organic material below/above the substrate (1=present). Remember to record the substrate underneath the organic material (in inorganic category). Record material only from stream bed.

Record the dominant substrate (inorganic or wood) at a minimum of 10 points across each cross-section

	Inorganic material category									Wood		
Substrate category	SI/SA	SG	SMG	MLG	LG	SC	LC	B	BR	SW (<25)	MW (25-100)	LW (>100)
Size (mm)/Cross-section #	<2	2-8	8-16	16-32	32-64	64-128	128-256	>256				
1	7			2						1		
2	8	1								1		
3	8			2								
4	5			3	1					1		
5	10											
6	7	1		1							1	
7	9				1							
8	9				1							
9	9			1								
10	8				1					1		

Record dominant organic material (if any) on substrate at same 10 points as substrate

Organic material category			
Cross-section #	Leaf litter	Periphyton, submerged macrophytes	Roots, plus emergent and floating vegetation
1		7	
2	1	9	
3		7	
4		5	
5	2	8	
6		5	
7	1	6	
8		10	
9		6	
10		5	

Substrate category descriptors

SI/SA	Silt/Sand	MLG	Medium-large gravel	LC	Large cobbles	SW	Small wood
SG	Small gravel	LG	Large gravel	B	Boulders	MW	Medium wod
SMG	Small-medium gravel	SC	Small cobbles	Bedrock		LW	Large wood

Appendix C : Fish Survey Data

"Mike Joy"
<m.k.joy@massey.ac.nz>
16/10/2008 07:52 p.m.

To "Adam S Forbes" <Adam.S.Forbes@nz.mwhglobal.com>
cc "Amber McEwan" <ambermcewan@slingshot.co.nz>
bcc
Subject Irongate stream

Adam here are results for Irongate:

We electrofished, trapped 3*fyke, 10* Gee minnow, and spotlight surveyed
Below and just above Maraekakaho rd we got
Shortfin eel abundant
Inanga rare
Common bully rare
Mosquito fish abundant
Goldfish common
One dead longfin eel - No koura
28 km from sea, 18m a.s.l.
IBI score = 30
This OK IBI but sediment big impact

Upper site off Irongate road
Koura abundant
Mosquito fish common
Shortfin eel abundant
IBI score 12

The low IBI is because only 1 native species and 1 introduced, so it reflects the lack of access for other species because of barrier, so from a fish point of view is impacted

Cheers Mike

Dr. Mike Joy
Senior Lecturer; Environmental Science/Ecology
Ecology group-Institute of Natural Resources-(PN-624)
Te Kura Matauranga o nga Taonga a Papatuanuku
Massey University
Private Bag 11 222
Palmerston North 4442
New Zealand
Ph. 64 6 3569099 ext 7363
Mob. 021 936205
Fax. 64 6 350 5623
websites:
http://femm.massey.ac.nz/index.html