



C & D Landfill Ltd

SEV Stream Assessment





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SEV Stream Assessment

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1 Introduction

A construction and demolition materials landfill has been operated by C&D Landfill Ltd at 2 Landfill Road, Happy Valley, Owhiro Bay, Wellington since the 1970s. An extension to the landfill is proposed within the valley on the site and resource consent application was lodged with Greater Wellington Regional Council (GWRC) in 2009. An unnamed stream, currently partly culverted (hereafter the 'C&D Landfill Stream'), runs along the base of the valley to be filled.

The proposed landfill extension will require further piping of this stream. An Assessment of Ecological Effects carried out by Wildland Consultants (Wildland Contract Report No. 2438b) in 2012 described the stream as being of high ecological value. After review by GWRC, further assessment of the stream using the SEV (Stream Ecological Valuation) method was requested to ensure mitigation suggested within the report is suitable and is sufficient to mitigate the effects of the proposed stream piping.

This report outlines the SEV assessment carried out on the C&D Landfill Stream, and two nearby stream reaches (potential mitigation sites) to which the C&D Landfill Stream is a tributary, by Opus International Consultants Ltd in September/October 2012. Results and comparisons with reference sites in the Wellington Region are described, along with discussion of the suitability of the proposed mitigation sites to offset the ecological effects of the landfill extension on the stream.

2 Methods

2.1 SEV stream assessment

A Stream Ecological Valuation (SEV) assessment was carried out on the Landfill Stream on September 5th 2012. The SEV assessment method, developed in Auckland to quantify stream ecosystem functions, allows subsequent calculation of an environmental compensation ratio (ECR), which can then be used as part of the decision-making process to propose an appropriate environmental compensation off-set. SEV groups ecological functions into the following categories:

Hydraulic functions (processes associated with water storage, conveyance, flood flow retention and sediment transport);

Biogeochemical functions (processes associated with processing of minerals, particulates and water chemistry);

Habitat provision functions (the type, amount and quality of habitat for flora and fauna); and

Native biodiversity functions (the occurrence of diverse populations of indigenous native plants and animals).

The original SEV methodology (Rowe et al, 2006) was reviewed in 2008 and again in 2011, resulting in small changes that have refined the methodology and provide a greater capacity to discriminate between sites. For this assessment we have used the 2011 version of the SEV (see Storey et al, 2011), recently modified specifically for use within the Wellington Region. Reference data relating to sites within the Wellington Region were obtained from GWRC, along with relevant

data to be used to calculate a fish index of biotic integrity (IBI, Joy & Henderson 2004). The reference data was originally collected using a previous version of SEV. Relating individual function scores between the original and revised SEV versions is not recommended (Storey et al, 2011), however it is considered that biodiversity and habitat provision function mean scores, and overall mean SEV scores can be related with confidence (Storey et al, 2011; R. Storey, pers. comm.).

2.2 Streams assessed

C&D Landfill Stream

At least 550m of this permanently flowing second-order stream exists upstream of a large culvert protected by a metal debris cage (Wildland, 2012). The stream then runs through a culvert for approximately 500m underneath part of the landfill site, Landfill Road and the Wellington City Council waste recycling centre. A reach of approximately 600m of open stream upstream of the culvert debris cage was assessed. Ten cross sections (separated by approximately 60m) were sampled along this reach according to SEV methodology (Storey et al, 2011; Neale et al, 2011) (Figure 1).

Smaller ephemeral tributaries to the C&D Landfill Stream were considered for SEV assessment. Of these, most were found to be very low-flow (essentially seeps running through large rock scree), although two (ephemeral tributary 1 and 3, Figure 1) were large enough to assess. It was decided that for the purposes of establishing an SEV score to subsequently calculate stream length to be restored in compensation for the landfill works, an SEV score from the main Landfill Stream would adequately describe the ecological values of the total affected stream area including tributaries, and therefore the SEV assessment was confined to the main Landfill Stream.

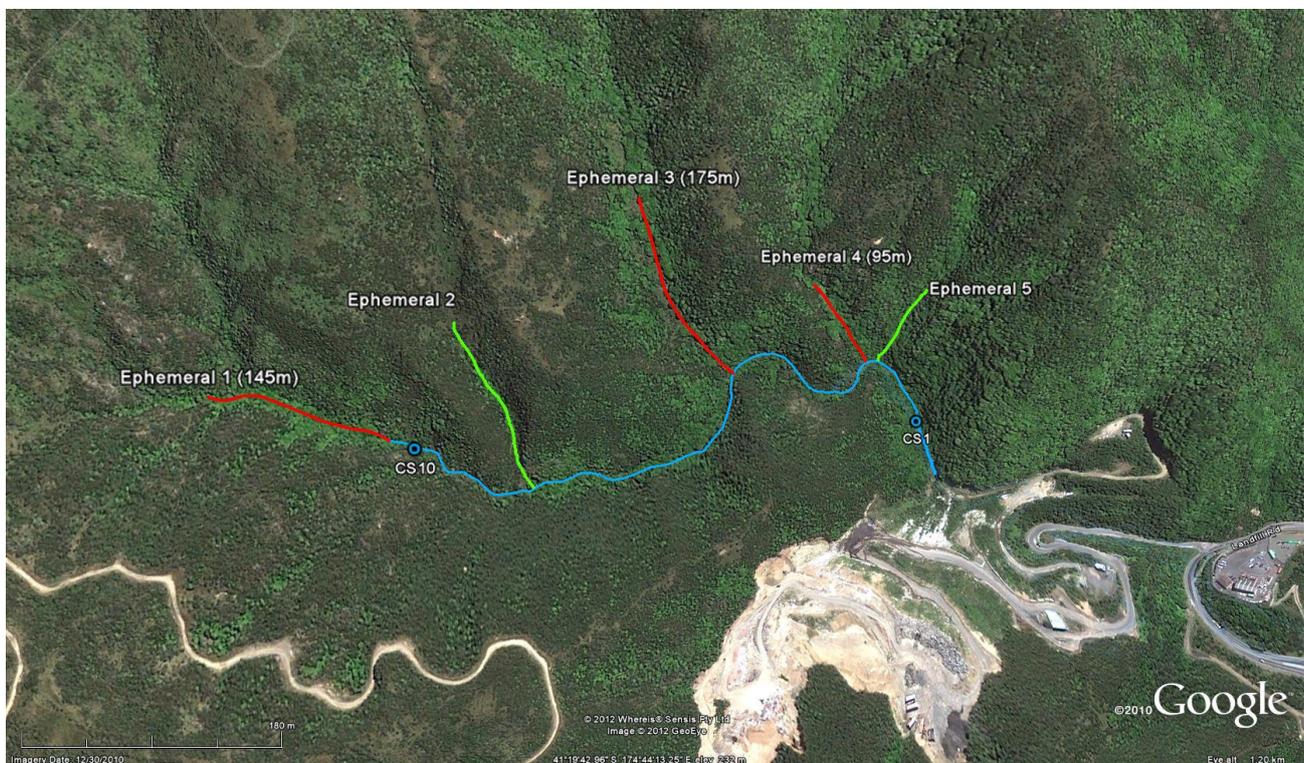


Figure 1. C&D Landfill Stream reach assessed (blue), with sections of ephemeral tributaries that lie within the planned fill area coloured red (included in compensation calculation) and green (not included in compensation calculation).

Landfill Rd and Owhiro Stream reaches

Two downstream reaches were identified as potentially suitable to undertake compensating restoration work. An SEV assessment was carried out at each of these sites to enable calculation of an Environmental Compensation Ratio (Storey et al, 2011).

Landfill Rd Stream (downstream of C&D Landfill Stream, running alongside Landfill Road) was assessed over a reach approximately 870m in length, between the culvert passing beneath Landfill Rd and the culvert at Happy Valley Road (Figure 2). Cross-sections were separated by approximately 90m.

Owhiro Stream was assessed over a reach approximately 450m in length, between the culvert running beneath Murchison Street and a point approximately 50m downstream of the footbridge between Domanski Crescent and Happy Valley Road at the southern end of the council playing fields (Figure 3). Cross-sections were separated by approximately 50m.

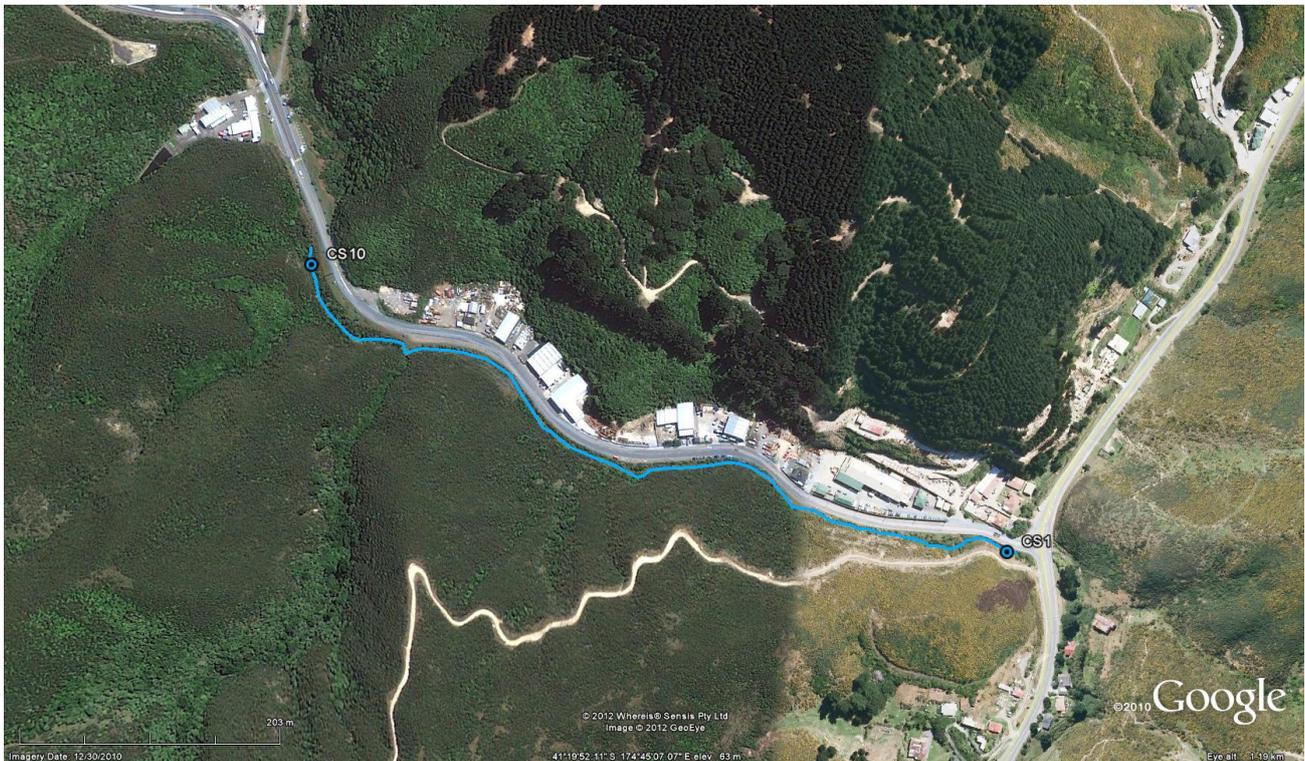


Figure 2. Stream running alongside Landfill Road with assessed reach coloured blue.

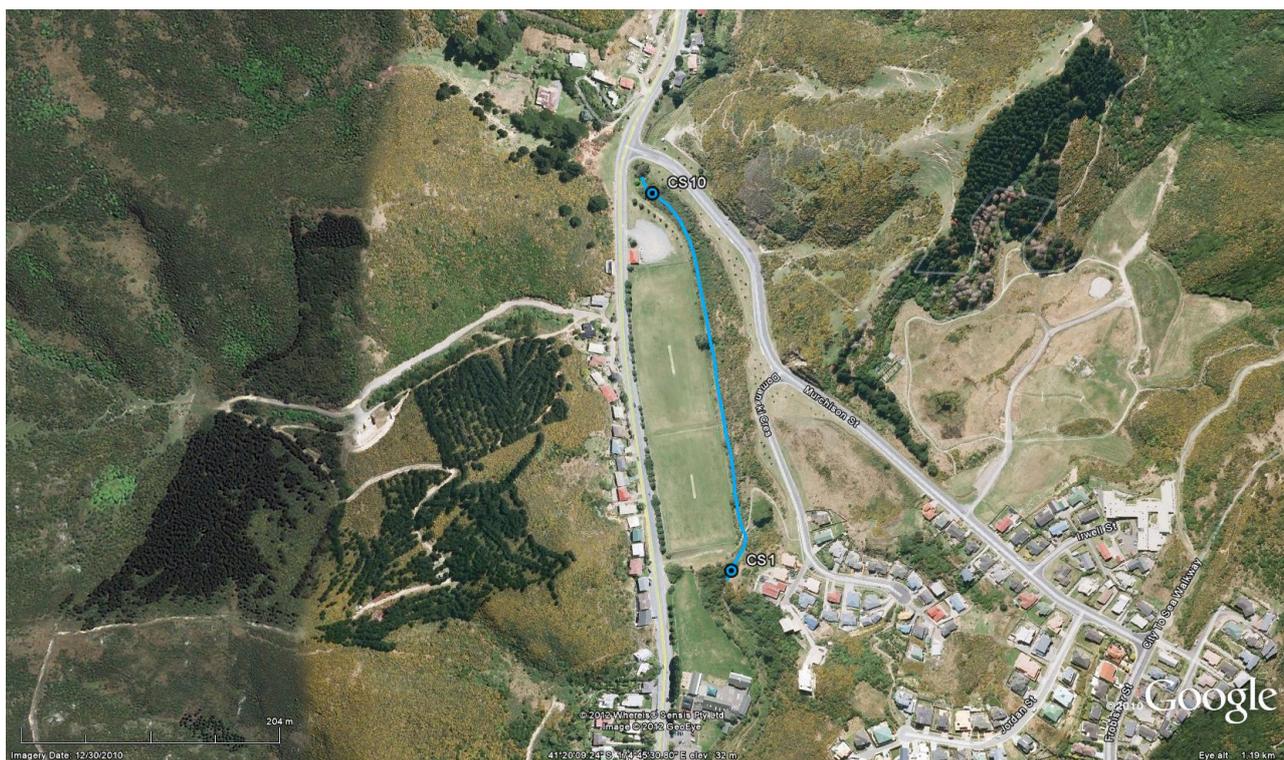


Figure 3. Owhiro Stream with reach assessed coloured blue.

2.3 Macro-invertebrate sampling

Within each stream reach, aquatic macro-invertebrates were sampled using national sampling protocol C1 (Stark et al, 2001). A kick net with mesh size 500µm was used to sample five quadrats each measuring approximately 0.2m², for a total of 1m². Invertebrate sampling was undertaken prior to in-stream assessment and fish sampling. Sorting and ID was completed according to protocol P2 (Stark et al, 2001).

2.4 Fish sampling

Desktop survey

The NIWA Freshwater Fish Database was checked to confirm species and location of fish recorded within the Owhiro catchment (accessed 12/10/12). This confirmed no further records other than those surveys referred to within the Wildland Consultants Assessment of Ecological Effects (Wildland, 2012).

C&D Landfill Stream

Following macro-invertebrate sampling and in-stream assessment, six Gee-minnow fish traps and one fyke net were set in the stream over the night of September 4th and retrieved the following day, after which the remainder of the SEV assessment was completed. The traps were set within the same 250m-long reach spotlight-surveyed by Wildland Consultants in January 2011 (Wildland, 2012). Although SEV methodology suggests a minimum of 10 Gee minnow traps should be used for an SEV survey, we have incorporated fish data gathered by Wildland Consultants during their

spotlight survey into our own data and consider this to be sufficient. Electrofishing equipment was not available for this or the subsequent Landfill Rd and Owhiro Stream surveys.

Landfill Rd & Owhiro Stream reaches

On the nights of October 2nd (Owhiro Stream) and 3rd (Landfill Rd), 10 Gee-minnow traps and two fyke nets were set overnight within each stream reach and checked the following day.

3 Results

3.1 Macro-invertebrate sampling

Summary of macro-invertebrates caught during sampling can be seen in Table 1. A more detailed breakdown of taxa can be found in Appendix 2.

Table 1. Summary of macro-invertebrates sampled within the three streams.

Stream	No. of taxa	% EPT	% EPT taxa	MCI
C&D Landfill Stream	20	84.10%	60%	137
Landfill Rd Stream	10	6.33%	30%	104
Owhiro Stream	7	0.06%	14.29%	77.14

3.2 Fish sampling

Species caught during fish surveys are listed in Table 2.

Table 2. Fish caught during surveys within the three streams assessed.

Stream	Species	Common name	No. caught	Threat status
C&D Landfill Stream	<i>Anguilla dieffenbachii</i>	Longfin eel	1	At risk - Declining
	<i>Galaxias fasciatus</i>	Banded kokopu	1	Not threatened
Landfill Rd Stream	<i>A. dieffenbachii</i>	Longfin eel	1	At risk - Declining
Owhiro Stream	<i>A. dieffenbachii</i>	Longfin eel	1	At risk - Declining
	<i>Gobiomorphus huttoni</i>	Redfin bully	2	At risk - Declining

3.3 SEV Scores

Individual function scores, function mean scores and overall SEV scores for all three streams can be seen in table 3. A comparison with three Wellington Region SEV reference streams can be seen in Appendix 1.

Table 3. Individual function, function mean and overall SEV scores for all three streams.

Function	C&D Landfill Stream	Landfill Rd Stream	Owhiro Stream
Natural flow regime	1.00	0.32	0.14
Floodplain effectiveness	0.80	0.00	0.00
Connectivity for species migrations	0.30	0.30	1.00
Natural connectivity to groundwater	1.00	0.74	0.76
Hydraulic function mean	0.77	0.34	0.47
Water temperature control	0.86	0.46	0.36
Dissolved oxygen levels maintained	1.00	1.00	1.00
Organic matter input	0.80	0.63	0.50
In-stream particle retention	0.95	0.28	0.28
Decontamination of pollutants	0.98	0.85	0.81
Biogeochemical function mean	0.92	0.64	0.59
Fish spawning habitat	0.81	0.44	0.15
Habitat for aquatic fauna	0.94	0.70	0.66
Habitat provision function mean	0.88	0.57	0.41
Fish fauna intact	0.80	0.27	0.37
Invertebrate fauna intact	0.63	0.29	0.11
Riparian vegetation intact	0.57	0.02	0.01
Biodiversity function mean	0.67	0.19	0.16
Overall SEV score	0.816	0.45	0.439

4 Discussion

4.1 C&D Landfill Stream

An overall SEV score of 0.816 indicates the ecological values of the C&D Landfill Stream are currently very high. The overall SEV score rates well in comparison to the three Wellington Region stream reference sites; the Habitat Provision function mean also rates very highly. These scores reflect the relatively unmodified nature of the stream channel, the positive influence of the dense regenerating riparian vegetation and the quality of in-stream habitat. Notably low scores include the Connectivity for Species Migrations function (a result of extensive downstream culverting). A large amount of rubbish was seen in the downstream reach nearest the debris cage although none was seen further upstream.

4.2 Landfill Rd Stream

In contrast to the C&D Landfill Stream, the Landfill Rd Stream reach rated lower with an overall SEV score of 0.45. Reasons for this can be seen within individual and mean function scores (Table 3). In particular, the incised, back-filled channel adversely affects a number of hydraulic, biogeochemical and habitat functions. Low levels of riparian vegetation and close proximity to impermeable road surfaces and industrial areas also contribute to the overall low score while the relatively low biotic scores reflect these factors and possibly also adverse effects of the Wellington City Landfill immediately upstream. Landfill rubbish was common within the stream including plastic bags, containers and larger items such as a broken plastic picnic table.

4.3 Owhiro Stream

The overall SEV score of 0.439 for the Owhiro Stream is similar to that of the Landfill Rd reach, and the back-filled and straightened channel again has a major influence on a number of variables. However mean and individual function scores indicate a number of differences. Owhiro Stream has no barriers to fish migration from the coast, although off-setting this is the lower score for Gobiidae spawning habitat, a reflection of the smaller in-stream substrate and lack of woody debris compared to the Landfill Rd Stream. Multiple stormwater pipe inputs also contribute to the lower overall score. Very low macro-invertebrate scores also reduce overall SEV value and again these are likely affected by the Wellington City Landfill upstream and possibly septic tank leachate from urban reaches upstream. Again, rubbish was commonly seen in the stream although generally this was limited to smaller items such as plastic bags.

4.4 Environmental Compensation Ratio (ECR)

Under the current plan to extend the landfill, a length of approximately 600m of open stream within the main C&D Landfill Stream and further lengths within several ephemeral tributaries will eventually be piped and filled over. Therefore a form of environmental compensation is required. In the context of SEV, the aim of environmental compensation is to achieve “no net loss of area-weighted stream function” (Storey et al, 2011). When calculating the area of stream that should be restored (using the ‘environmental compensation ratio’, ECR), both area and length of the stream reach that will be impacted must at least be conserved, and the ecological values of both the impacted site and the site chosen to be restored should be considered (Storey et al, 2011).

4.5 ECR calculation

The values required in order to calculate an ECR are –

- SEVi-P: potential SEV values for the stream to be impacted (C&D Landfill Stream);
- SEVi-I: the predicted SEV value of the stream to be impacted, after impact;
- SEVm-C: current SEV values for the stream to be mitigated; and
- SEVm-P: potential SEV values for the stream to be mitigated.

Environmental compensation in the context of SEV should ideally take place within the same catchment, in a reach of similar size and/or order to that being impacted (Storey et al, 2011). In this case, the realities of locating such a reach that is a) available to be restored, and b) in such a condition that significant improvements can be made through restoration, presents significant challenges.

Both streams assessed for restoration potential lie within the same catchment as the C&D Landfill Stream, however we suggest Owhiro Stream offers the highest potential for mitigating restoration work. The Landfill Rd stream reach was the longer of the two potential restoration streams, however the very steep loose scree banks, deep channel incision and close proximity of Landfill Road means there are only limited sections where significant re-vegetation work can occur. At points along the stream, erosion is still depositing scree and soil into the stream channel. Therefore in the first instance Owhiro Stream is the preferred option to propose restoration.

Here we calculate the ECR based on using Owhiro Stream as our mitigation stream.

Estimated values (and individual scores that comprise them) are detailed in Table 4. Biotic factors (IFI & FFI) were excluded from all estimated SEV values as per SEV methodology. Assumptions made include:

- For 'Potential' SEV scores, individual function scores were estimated based on a restored stream area 10 years after completion of best practice restoration work.
- For 'Potential' SEV scores, restoration is assumed to include –
 - Extensive, high-quality riparian planting undertaken to maximise stream shade, create a dense, uniform ground cover to increase filtering action and diffuse runoff, and increase quality of potential Galaxiidae spawning habitat. This work would include substantial weed removal.
 - Some near-flat terracing re-established by clearance of choking weeds and replacement with suitable native vegetation over a proportion of stream banks immediately above normal-flow water level to increase area of Galaxiidae spawning habitat (see figure 4).
 - Addition of 'roughness elements' (e.g. boulders and woody debris) of various sizes, to increase the quality and variety of in-stream habitat.
 - Extraction of rubbish from the stream channel (see figure 5).

Table 4. SEV scores used to calculate ECR.

Function	SEVi-I	SEVi-P	SEVm-C	SEVm-P
Natural flow regime	0.02	1.00	0.14	0.14
Floodplain effectiveness	0.00	1.00	0.00	0.00
Connectivity for species migrations	0.30	0.30	1.00	1.00
Natural connectivity to groundwater	0.07	1.00	0.76	0.76
Hydraulic function mean	0.10	0.83	0.47	0.47
Water temperature control	1.00	1.00	0.36	1.00
Dissolved oxygen levels maintained	1.00	1.00	1.00	1.00
Organic matter input	0.00	0.80	0.50	0.70
In-stream particle retention	0.20	1.00	0.28	0.28
Decontamination of pollutants	0.11	1.00	0.81	0.82
Biogeochemical function mean	0.46	0.96	0.59	0.76
Fish spawning habitat	0.05	0.81	0.15	0.71
Habitat for aquatic fauna	0.61	1.00	0.66	0.91
Habitat provision function mean	0.33	0.91	0.41	0.81
Fish fauna intact	-	-	-	-
Invertebrate fauna intact	-	-	-	-
Riparian vegetation intact	0.00	0.80	0.00	0.29
Biodiversity function mean	0.00	0.27	0.00	0.01
Overall SEV score	0.223	0.743	0.368	0.513

Using these scores the ECR is calculated as follows:

$$\text{ECR} = ((\text{SEVi-P} - \text{SEVi-I}) / (\text{SEVm-P} - \text{SEVm-C})) \times 1.5$$

$$\text{ECR} = ((0.743 - 0.223) / (0.513 - 0.368)) \times 1.5$$

$$\text{ECR} = 5.38$$

Therefore the area of stream to be restored must be at least 5.38 times the area of the stream that will be lost.



Figure 4: Section of Owhiro Stream showing a small flood terrace on the left that could be cleared and planted with native sedges to re-create potential galaxiid breeding areas.

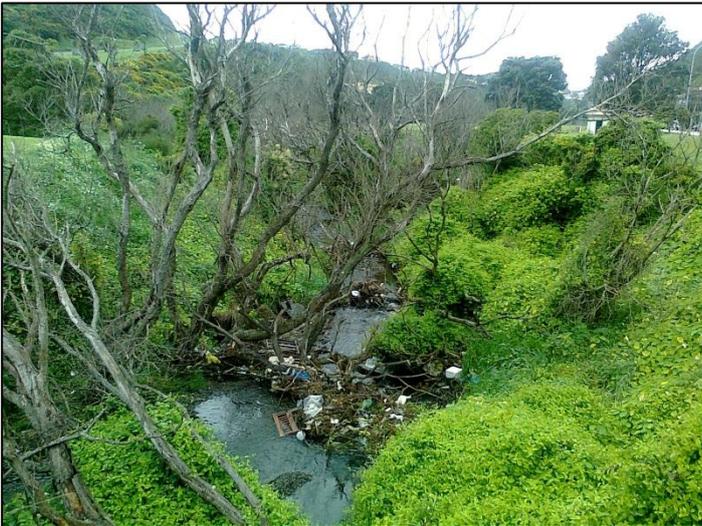


Figure 5: Section of Owhiro Stream below Murchison St. Removal of the rubbish and debris from the channel, extraction of the dead trees, and replacement of the wandering jew growing on the banks with native riparian vegetation would greatly improve the quality of the aquatic habitat.

4.6 Stream area and length be restored

In order to calculate the area and length of stream that SEV methodology requires should be restored, the area and length of stream to be piped under the proposed landfill extension is required. These figures can be seen in Table 5.

Permanent Stream

Wildland Consultants estimated at least 550m of permanent stream lay above the debris cage. We put this length at 600m (Figure 1), with the stream above this length becoming intermittently subterranean and henceforth described as ephemeral.

Although there are numerous wider pools, for the most part the width of the lower reach is approximately 1m, and this narrows further upstream. On average we put the width of the stream at approximately 0.75m over the entire reach.

Ephemeral tributaries

Five ephemeral tributaries were identified in the Wildland AEE. In our view, three of these tributaries offer habitat of high enough ecological value to be compensated for. These can be seen in Figure 1 (labelled 'Ephemeral 1', 'Ephemeral 3' and 'Ephemeral 4', coloured red). The remaining two are essentially trickles through large scree (Figure 1, coloured green). We therefore propose to compensate for the areas of the three ephemeral tributaries offering high ecological value that will be piped.

ECR

Total stream area to be impacted is multiplied by the ECR value (5.38) to obtain total stream area to be restored in compensation. This figure can also be seen in Table 5, along with minimum length of stream to be restored. Note, all length and area figures have been rounded to the nearest whole number.

Table 5. Length, width and area of reaches to be impacted by the proposed landfill extension, and compensated according to SEV methodology.

Reach	Length affected	Average width	Area impacted	Area to be restored
Main stream	600m	0.75m	450m ²	2,421m ²
Ephemeral 1	145m	0.20m	29m ²	285m ²
Ephemeral 3	175m	0.30m	53m ²	102m ²
Ephemeral 4	95m	0.20m	19m ²	156m ²
TOTAL	1,015m	n/a	551m²	2,964m²

A total minimum stream area of 2,964m² is required to be restored within Owhiro Stream under SEV methodology. The length of stream that is required to be restored to provide this area depends on the width of the available stream. We estimate the average width of Owhiro Stream at the reach assessed to be approximately 2.5m; using this figure, if Owhiro Stream is to be the stream chosen for restoration, a total stream length of **1,186m** of stream would need to be restored to compensate for the impacts of the proposed landfill extension. This length is also greater than the 1,015m of stream that will be impacted.

4.7 Restoration options

Owhiro Stream extends for approximately 1500 metres from the Murchison St Bridge down to the coast. About 300 metres of that reach has been, or is being restored by the local school. Of the remaining 1200 metres, an estimated 935 metres runs through Wellington City Council land and the rest passes through private land. If all landowners agree to allow restoration planting to occur along the stream on their land then there is adequate mitigation area available to generate the required 2,964m² of stream surface area (1186m long x 2.5m wide).

If, however, sufficient length of Owhiro Stream is not available for restorative works it is proposed that the difference be made up by restoring sections of the C & D Landfill stream reach along Landfill Road. Sections of this stream reach, especially those where the stream meanders away from Landfill Road, offer good opportunities for re-vegetation to occur and for significant enhancement of the aquatic habitat to be achieved. Restoration of Owhiro Stream will provide conditions more suited than currently to the upstream movement of native fish and aquatic

invertebrates and there are sections of the Landfill Road stream reach that offer potentially favourable galaxiid breeding conditions if further restorative work is undertaken. All of the Landfill Road Stream reach lies on Wellington City Council land.

4.8 Next steps

Once the approval of the consenting authority and stakeholders has been obtained and the resource consents for the landfill extension are granted, a full restoration plan will need to be produced. This restoration plan should include:

- Determination of the availability of the land along the Owhiro Stream for restoration works. This will include discussions with Wellington City Council to obtain permission and access to restore their reserve land and interaction with the private land owners who have Owhiro Stream passing through their land to determine whether restoration can occur.
- Determination of how much, if any, of the Landfill Road stream needs to be restored to meet the ECR value. This would be followed by selection of sections of the stream that will benefit most from restoration, especially the small stream deltas that exist at the junction of some of the tributaries that link with this stream.
- Production of a full restoration works programme that will include a list of physical pre-planting works that need to be undertaken, including mechanical rubbish, debris and dead tree removal, and weed control; a planting list for the full restoration zone; practical planting and site preparation advice; recommended timing and prioritisation of works; and a full 5 year maintenance programme. The production of this programme should involve liaison with Wellington City Council and the local community streamcare group.
- An annual monitoring programme to provide feedback of progress and success to the consenting authority.

5 References

- Neale, M.W., Storey, R.G., Rowe, D.K., Collier, K.J., Hatton, C., Joy, M.K., Parkyn, S.M., Maxted, J.R., Moore, S., Phillips, N., Quinn, J.M. 2011. Stream Ecological Valuation (SEV): A User's Guide. Auckland Council Technical Report 2011/001.
- 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. Sustainable Management Fund Project No. 5103.
- Storey, R.G., Neale, M.W., Rowe, D.K., Collier, K.J., Hatton, C., Joy, M.K., Maxted, J.R., Moore, S., Parkyn, S.M., Phillips, N., Quinn, J.M. 2011. Stream Ecological Valuation (SEV): a method for assessing the ecological functions of Auckland streams. Auckland Council Technical Report 2011/009.
- Wildland Consultants Ltd, 2012. Assessment of Ecological Effects for a proposed expansion of C&D Landfill, Happy Valley, Wellington. Contract Report No. 2438b. Wildland Consultants Ltd, Porirua.

6 Appendix 1. Comparison of assessed streams with reference sites.

<i>Function</i>	<i>C&D Landfill Stream</i>	<i>Landfill Rd Stream</i>	<i>Owhiro Stream</i>	<i>Tirohanga Stream*</i>	<i>Speedies Stream*</i>	<i>Speedies tributary*</i>
Natural flow regime	1.00	0.32	0.14			
Floodplain effectiveness	0.80	0.00	0.00			
Connectivity for species migrations	0.30	0.30	1.00			
Natural connectivity to groundwater	1.00	0.74	0.76			
Hydraulic function mean	0.77	0.34	0.47			
Water temperature control	0.86	0.46	0.36			
Dissolved oxygen levels maintained	1.00	1.00	1.00			
Organic matter input	0.80	0.63	0.50			
In-stream particle retention	0.95	0.28	0.28			
Decontamination of pollutants	0.98	0.85	0.81			
Biogeochemical function mean	0.92	0.64	0.59			
Fish spawning habitat	0.81	0.44	0.15			
Habitat for aquatic fauna	0.94	0.70	0.66			
Habitat provision function mean	0.88	0.57	0.41	0.80	0.77	0.79
Fish fauna intact	0.80	0.27	0.37			
Invertebrate fauna intact	0.63	0.29	0.11			
Riparian vegetation intact	0.57	0.02	0.01			
Biodiversity function mean	0.67	0.19	0.16	0.93	0.89	0.84
Overall SEV score	0.816	0.45	0.439	0.88	0.81	0.77

* Note reference sites were surveyed using the original version of SEV (see Rowe et al, 2006) and therefore only function mean and overall SEV scores can be compared. Reference data supplied by Greater Wellington Regional Council.

7 Appendix 2. Breakdown of macro-invertebrates sampled within the three stream reaches.

Taxa	MCI score	No. of individuals		
		C&D Landfill Stream	Landfill Rd Stream	Owhiro Stream
<i>Coloburiscus</i>	9	28		
<i>Deleatidium</i>	8	6	13	
<i>Neozephlebia</i>	7	1		
<i>Nesameletus</i>	9	1		
<i>Zephlebia</i>	7	14		
<i>Spaniocerca</i>	8	8		
<i>Stenoperla</i>	10	13		
<i>Zelandobius</i>	5	3		
<i>Zelandoperla</i>	10	2		
<i>Aoteapsyche</i>	4	15		1
<i>Costachorema</i>	7		11	
<i>Hydrobiosella</i>	9	10		
<i>Olinga</i>	9		1	
<i>Orthopsyche</i>	9	100		
<i>Archichauliodes</i>	7	8	1	
Elmidae	6	1		
Ptilodactylidae	8	21		
<i>Aphrophila</i>	5		2	4
<i>Corynoneura</i>	2	2		
<i>Maoridiamesa</i>	3		30	600
Orthoclaadiinae	2		298	1080
<i>Paralimnophila</i>	6	1		
<i>Polypedilum</i>	3	3		
Tanypodinae	5	1	4	
<i>Paranephrops</i>	5	2		
Talitridae	5		10	9
Mites	5			1
Lymnaeidae	3			1
Oligochaeta	1		25	



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