Ecology and Landscape Management Plan

September 2018

Mt Messenger Alliance

MMA-ENV-ECL-RPT-3237

NZ TRANSPORT AGENCY WAKA KOTAHI | Mt Messenger Bypass

New Zealand Government

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Revision schedule		
Rev. Number	**Date**	**Description**
A	March 2018	Draft for discussion
B	10 May 2018	Draft for discussion
C	25 May 2018	Updated for Council
D	17 July 2018	Updated for Council Hearing
E	6 August 2018	Updated during Council Hearing
F	28 September 2018	Updated during Council Hearing

The purpose of this Ecology and Landscape Management Plan (ELMP) is to avoid, remedy, mitigate and offset potential adverse effects on the ecological and biodiversity values of the land within the Project area and its surrounds. The ELMP should be read alongside the Landscape and Environmental Design Framework (LEDF) which is the overarching framework that guides the landscape aspects of the ELMP (including restoration of natural vegetation and streams, and revegetation of works), along with other components of the detailed design such as those relating to earthworks, structures, highway furniture, and cultural expression.

1.1.1 Riparian offset restoration planting

The waterways that will be affected by the Project have been assessed in the Freshwater Ecology Technical Report using the Stream Ecological Valuation (SEV) calculator. Technical Report 7b – Freshwater Ecology (December 2017) assessed that 3361 square metres of stream surface area of variable ecological value will be adversely affected by the construction and operation of the Project. The SEV model has calculated that restoration (fencing and planting) of 10,738 square metres of stream will be necessary to offset those impacts. This equates to approximately 8,455 lineal metres of stream length (the streams affected have an average width of 1.27m). This equates to approx. 16.91ha of terrestrial riparian margin required.

Commented [td1]: Square metre figure reported here has been reduced from what KH reported in his speaking notes at the hearing. See para 7 of his second set of speaking notes.

1.1.1.1 Potential stream restoration planting locations

As is the case for all biodiversity offsetting, it is best practice to undertake stream restoration efforts close to the affected area and in similar environmental conditions. Suitable stream restoration sites exist in the areas adjacent to and near the Project.

The following areas, in descending order of preference, are considered suitable sites for stream-riparian restoration:

- 2600m length of the Mangapepeke Stream that passes through pasture and exotic rushland on Ngāti Tama land (1000m) and the Pascoe property (1600m).
- Up to 800m of tributary streams that flow into the Mangapepeke Stream, mostly on the Pascoe property, that are currently in pasture or sedges/rushes.
- Approximately 1000m of the eastern branch of the Mimi Stream on DOC land (350m) and on the Thomson property down to where the branch of the stream meets SH3 (650m).
- Up to 4962m of the Mimi Stream, through multiple properties (Thomson, Anglesey and Scott), as it flows south parallel to SH3.
- Up to 1600m of tributaries flowing to the Mimi Stream from DOC land to the east of the Thomson, Anglesey and Scott properties.

All riparian restoration areas used will require the Transport Agency to acquire the necessary rights to implement the restoration programme. Informal agreements with Ngati Tama, Thomson, Angelsey and Scott have been obtained and the production of formal written agreements is progressing.

Commented [td2]: This lack of confirmation of landowners is why I would prefer the riparian planting figure to be presented in square metres, as opposed to 8.455 km stream length.

1.1.1.2 Nature of the stream restoration and likely outcomes

Stream restoration work will consist of planting a 10m buffer (on average) on each side of the channel and fencing off the stream and buffer plantings from livestock. None of the streams under consideration are currently fenced.

Stream buffer plantings will consist of a mix of indigenous riparian margin sedges, shrubs and trees. The primary objective is to provide shade and organic matter to the stream channel to improve the quality of habitat for native fish and invertebrates. A reduction of sediment and nutrient loads entering the streams will also be achieved by fencing and planting, especially along the stream sections that pass unfenced through farmland.

With the necessary rights to implement the restoration programme, swamp forest restoration planting and stream restoration planted in adjoining areas will provide greater ecological outcomes than either in isolation. Potential sites where this could likely occur include along the

on fish passage will be minimised by following procedures described in Chapter 6.6 of the CWMP. This includes:

- Timing of online stream diversion works to avoid peak fish migration and spawning seasons ~~if the Projects freshwater ecologist deems there to be suitable fish habitat upstream of the works area~~;
- Timing of works will be during a suitable fine weather window;
- Providing appropriate fish passage for culverts;
- Undertaking work offline (outside the active stream channel). In circumstances where online works are proposed the Project freshwater ecologist will consult with site engineers to determine the best practicable method for undertaking the works incorporating best practice methodologies ; and
- Follow the FRRPs.

In addition, Specific Construction Water Management Plans (SCWMPs) will be prepared for stream works to confirm:

- Design details, including fish passage provisions (refer sections 1.1.4.1, 1.1.1.4 and 1.1.1.5);
- The method of construction;
- Stream dewatering and reclamation;
- Stream diversion method (online or offline) to allow construction near or within the active stream channel; and
- Timing of works to avoid peak fish migration ~~in areas where the Project Freshwater Ecologist deems there to be suitable fish habitat upstream of the works area~~.

Commented [td3]: Not comfortable with this – remove

Commented [td4]: Not comfortable with this – remove

1.1.1.3 Timing of works

One way to reduce the potential effects of earthworks on fish spawning and migration is to avoid or minimise works during months when key fish species in the catchment may be migrating or spawning. For the Project there are practical constraints in seasonally stopping work across the whole site and it may increase the risk of erosion if it means the construction phase takes appreciably longer. However, where there is an opportunity to adjust the timing of works in particular catchments to reduce effects on fish spawning and migration that will be explored.

Commented [td5]: Not overly persuasive that the timing of works will in fact be changed.

Generally, it is more important to maintain unimpeded fish passage during peak migration periods for streams with larger upstream catchments than those with small upstream catchments. This principle can be used to direct the timing of works in different parts of the catchment. Where practicable, avoid large scale instream works during August to October and April to June (inclusive). These are the spawning seasons for redfin bully and giant kōkopu respectively. This condition particularly applies to the large areas of fill (fill 12 and 13) required near the tunnel portals but should be applied flexibly to avoid the work being left incomplete over the winter season.

1.1.1.4 Fish passage through temporary culverts

Measures to minimise the short-term effects of all temporary culvert construction on fish passage are described in the Construction Water Management Plan (CWMP). These include

minimising the length of time construction activities cause a fish passage barrier by constructing culverts and diversions in the dry, where possible.

In the large area of fill (fill 12 and 13) near the tunnel portals, the short-term effects on fish passage will be mitigated either by installing spat rope through the culvert or by implementing trap and transfer. The approach is dependent on the timing and duration of works, on physical stream characteristics such as stream flow and the quality and quantity of suitable fish habitat determined by the Project freshwater ecologist upstream of the temporary culvert. The method will be detailed within the SCWMP.

Commented [td6]: Decisions like these need to be checked/certified by TRC or Ecology Review Panel.

Where spat rope is used to provide short-term fish passage they will be installed in the following way:

- A minimum of three rope lines are used;
- Ropes will be installed so that they are tight and flush with the base of the culvert through the entire length of the culvert and not out of the water;
- Ropes will be set out to provide 'swimming lanes' between the ropes;
- Knots (half hitches) will be tied along the sections of rope in the culvert barrel to break up the flow; and
- Non-loop rope types will be used to reduce the likelihood of debris snagging on the ropes.

1.1.1.5 Fish passage through permanent culverts

A description of culvert design and approach to fish passage for each culvert is provided in the Culvert Schedule and Typical Drainage Details (Drawing Number MMA-DES-DNG-CO-DRG-4006), and Tables 1 and 2 attached in Appendix E. This includes culvert dimensions, length, grade and general approach to fish passage.

Priorities for fish passage at specific culvert locations has been assessed by the Project Freshwater Ecologist, and has been used to inform fish passage design taking into account the NIWA, New Zealand Fish Passage Guidelines, April 2018. Table C-1 summarises these design considerations.

At all other culvert locations, improvements for fish passage will be designed in general accordance with the NZ Transport Agency fish passage guidance for state highways (2013), where:

- Type 1 Culvert, steep gradient (ca. >1%): fish passage will be provided by installing baffles within the culvert. Baffles will be appropriately spaced for the culvert gradient to ensure continuous fish passage;
- Type 2 Culvert, shallow gradient (ca. <1%): the culverts will be sufficiently sized to allow for fish passage. The culvert's downstream invert will be set below the existing stream bed by at least 25% of the culvert diameter and not less than 200mm. This is to help retain stream substrate in the base of the culvert;
- Type 2 culverts with a grade between 0.5% and 1% will have baffles as required or equivalent features to retain substrate and ensure fish passage.

  If practicable, the final design of Type 2 culverts will reduce the grade to less than 0.5% and preferably closer to 0.3% grade, unless the natural stream channel is steeper;

Table Error! No text of specified style in document.**.1 – Stream monitoring locations and method summary**

Monitoring ID	Site	Catchment	Coordinates (NZTM)		Type	Description and notes
			Latitude	Longitude		
EM1	Ea10a	Mangapepeke	38.883153	174.605548	M, F	Control site, on an unnamed tributary 40 m upstream of the confluence with the Mangapepeke stream.
EM2	E2	Mangapepeke	38.875669	174.600579	M, F	Downstream ecology site on Mangapepeke Stream.
EM3	u/s E4	Mangapepeke	38.888551	174.601769	M, F	Downstream of fill 12 (40 m u/s of E4). Grid reference for most downstream end of the reach.
EM4	u/s Ea25	Mimi	38.902360	174.597168	M, F	Control site, upstream of works. Potential restoration area.
EM5	d/s E6	Mimi	38.902147	174.596495	Se	Event based sediment deposition monitoring site (330 m d/s of E6).
EM6	Ea25	Mimi	38.903034	174.594584	F	~~Event based monitoring~~D ~~d~~ownstream of fill 13 (in Mimi swamp forest).
EM7	d/s E6	Mimi	38.900135	174.596815	M	Downstream of fill 13 (100 m d/s of E6).
EM8	Ea26	Mimi	38.903309	174.591411	W, M, F	Downstream sites located on tributary to the Mimi Stream (just upstream of confluence).

Notes F = fish, M = Macroinvertebrates, Se = Sedimentation Plates, W = water quality

1.1.2 Pre-construction monitoring - baseline

1.1.2.1 Water quality during rain events

Water quality during rain events is currently being monitored in the Mangapepeke Stream and the Mimi Stream using passive samplers. In each catchment there is a site near downstream of the extent of works and a control site in an adjacent paired catchment. All of these sites provide a preconstruction baseline water quality data set. This water quality monitoring is described in the CWMP.

1.1.2.2 Sediment deposition

Sediment plates[1] have been established at the end of the stream channel downstream of site E6 (monitoring ID EM5). This site is within the raupo reedland, downstream of the Mimi Stream tributary draining the tunnel portal, located upstream of the Mimi swamp forest.

The purpose of the sediment plates is to monitor any sediment deposition that might extend from the end of the stream to the Mimi swamp forest. The plates will be monitored following heavy rain events during the baseline period and weekly during construction but are primarily intended to be monitored if there is a sediment release event in the upstream catchment.

1.1.2.3 Fish monitoring

Fish monitoring will be undertaken during base flow conditions at least two weeks following any large flood event. The sampling will occur biannually for one summer period immediately prior to earthworks (spring sampling – October to December and summer sampling February to April).

The sites sampled for fish monitoring will be:

Mangapepeke catchment:

- EM1 at site Ea10a (control);
- EM3 at site u/s E4 (downstream of fill 12); and
- EM2 at site E2 (downstream).

Mimi catchment:

- EM4 at site u/s Ea25 (control);
- EM6 at site Ea25 (Mimi swamp forest); and
- EM8 at site Ea26 (downstream). [2]

Fish surveys will use methods consistent with the New Zealand freshwater fish sampling protocols (Joy et al. 2013). At most sites sampling will occur with fine-mesh fyke nets and gee

[1] The sediment plates used are artificial astroturf attached to a tray on and placed on the sediment surface; accumulation is measured within and above the astroturf. Fine sediment is measured as millimetres deposited on the plate, recorded as the average of three readings per plate.

[2] Fish monitoring is not proposed for site d/s E6 due to very low fish abundance found in previous surveys (e.g. 2 banded and 1 longfin in a 220m reach during November 2017). The natural low fish abundance at this site makes it an unreliable measure for assessing effects. Monitoring fish at site Ea25 prior to construction provides a better baseline for ~~event-based~~ monitoring.

minnow traps. At each site a minimum of six fyke nets will be deployed over an ca. 150m reach. Spotlighting will be undertaken at all sites.

At the site u/s E4 fish will be surveyed over a ca. 150m reach using the backpack electro-fishing method. This site has gravel substrate and relatively shallow water suited to electro-fishing.

Fish will be identified, counted and lengths recorded. The results will be reported as total caught and in terms of catch per unit effort (CPUE).

1.1.2.4 Aquatic macroinvertebrate monitoring

Aquatic macroinvertebrate monitoring will be undertaken during base flow conditions at least two weeks following any large flood event. Sampling will be undertaken during spring (October to December) and summer (February and March) ~~The sampling will occur biannually for one summer period i~~immediately prior to earthworks ~~(spring sampling – October to December and summer sampling February to April)~~.

The sites sampled for aquatic macroinvertebrate monitoring will be:

Managapepeke catchment:

- EM1 at site Ea10a (control), soft-bottom~~, one replicate~~;
- EM3 at site u/s E4 (downstream of fill 12), hard-bottom, five replicates; and
- EM2 at site E2 (downstream), soft-bottom, ~~one replicate.~~

Mimi catchment:

- EM4 at site u/s Ea25 (control), soft-bottom, ~~one replicate~~;
- EM7 at site d/s E6 (downstream fill 13), hard-bottom, five replicates ; and
- EM8 at site Ea26 (downstream), soft-botto~~mm, one replicate~~.

Aquatic macroinvertebrate sampling at all sites will be undertaken following Protocols C3 (hard-bottomed, quantitative) or C4 (soft-bottomed, quantitative), as set out in Stark et al. 2001) – 'Protocols for sampling macroinvertebrates in wadeable streams'. The choice of protocol (C3 or C4) will be determined by the physical character of each individual site.

A minimum of three replicate samples will be collected at each site. Samples should be processed using Protocol P3 – Full count with subsampling option.

Sampling should be undertaken during spring (October to December) and summer (February and March) each year, with all sites being sampled during the same sampling round (as per TRC's State of Environment Monitoring [SEM] programme – TRC [2017]). ~~Aquatic macroinvertebrate surveys will use methods consistent with Protocols for sampling macroinvertebrates in wadeable streams (Stark et al. 2001). At most sites (i.e. Ea10, E2, u/s Ea25 and Ea26) the sampling will use the semi-quantitative method for soft-bottomed streams (Protocol C2). A single replicate will be collected from stable habitat (e.g. bank margins, wood, macrophytes) sampled along a 50m to 100m reach. A consistent sampling effort will be applied at each site as described in Protocol C2. Samples from these sites will be processed using Protocol P2 – 200 Individual Fixed Count with Scan for Rare Taxa.~~

~~At the sites u/s E4 and d/s E6 sampling will use the quantitative method for hard-bottomed streams (Protocol C3). Five replicates will be collected along a 50m to 100m reach from riffle~~

~~habitat using a Surber sampler.[3] These sites have gravel substrate suited to using hard-bottomed sampling protocol. Samples from these sites will be processed using Protocol P3 – full count with subsampling option.~~

For each site the area sampled and type of stable habitat sampled will be recorded. The following metrics will be calculated from the aquatic macroinvertebrate data: taxa richness, Macroinvertebrate Community Index (MCI), Quantitative Macroinvertebrate Community Index (QMCI), %EPT taxa and %EPT abundance. EPT (Ephemeroptera-Plecoptera-Trichoptera) metrics will exclude the species *Oxyethira* and *Paroxyethira*.

Habitat and sediment characteristics will be measured along each reach where aquatic macroinvertebrate samples are collected.

The habitat measures shall include:

- Macrophyte cover assessed using the rapid assessment protocol in the 'Regional Guidelines for Ecological Assessment of Freshwater Environments: aquatic plant cover in wadeable streams' (Collier et al. 2014). This involves assessing emergent and submerged macrophyte cover and type occupying a one metre wide belt across the stream at five transects spaced along the reach;
- Sediment cover: bankside visual estimate of percent cover, Sediment Assessment Method 1 in Clapcott et al. (2011);
- Substrate size – wolman pebble count, Sediment Assessment Method 3 in Clapcott et al. (2011); and
- Resuspendable sediment (Shuffle Index), Sediment Assessment Method 5 in Clapcott et al. (2011).

1.1.3 Monitoring during construction

Construction monitoring will commence when construction begins upstream of a section of stream and finish when construction activities affecting any given catchment are complete. Aquatic macroinvertebrate and fish population monitoring will be carried out bi-annually (twice yearly) at all of the ecological monitoring sites listed above (except for site EM5) for the entire duration of the Project, not just when construction activities (i.e., earthworks) are occurring within that (sub)catchment. Methods to follow those listed in Sections 8.4.2.3 – 8.4.2.4.

~~1.1.3.1 Fish monitoring~~

~~Fish monitoring will be undertaken during base flow conditions at least two weeks following any large flood event. The sampling will occur biannually for one summer period immediately prior to earthworks (spring sampling – October to December and summer sampling February to April).~~

~~[3] Quantitative sampling of aquatic macroinvertebrates is only proposed at the two sites downstream of the fill (u/sE4 and d/s E6) because these sites more sensitive and have hard-bottomed substrate. Quantitative sampling methods are more consistent and reliable for hard-bottom sites compared to the soft-bottom sites which have variable instream habitat and often lack macrophytes.~~

The sites sampled for fish monitoring will be:

Managapepeke catchment:

- EM1 at site Ea10a (control);
- EM3 at site u/s E4 (downstream of fill 12 only during filling activity); and
- EM2 at site E2 (downstream).

Mimi catchment:

- EM4 at site u/s Ea25 (control);
- EM6 at site Ea25 (downstream fill 13 only during filling activity); and
- EM8 at site Ea26 (downstream).[4]

It is noted that sampling at site u/s E4 and Ea25 will only occur during the fill activity. It is also noted that following at least one year of baseline monitoring and one year of construction monitoring, aquatic macroinvertebrate monitoring will be reduced from to twice yearly (spring and summer) to annual monitoring during summer. This reduction in frequency may occur at all sites if the first year of monitoring finds only small changes in the fish community compared to baseline sampling after accounting for any variation at the control site.

Fish surveys will use methods consistent with the New Zealand freshwater fish sampling protocols (Joy et al. 2013). At most sites sampling will occur with fine-mesh fyke nets and gee minnow traps. At each site a minimum of six fyke nets will be deployed over an ca. 150m reach.

At the site u/s E4 fish will be surveyed over a ca. 150m reach using the backpack electro-fishing method. This site has gravel substrate and relatively shallow water suited to electro-fishing.

Fish will be identified, counted and lengths recorded. The results will be reported as total caught and in terms of catch per unit effort (CPUE).

1.1.3.2 Aquatic macroinvertebrate monitoring

Aquatic macroinvertebrate monitoring will be undertaken during base flow conditions at least two weeks following any large flood event. The sampling will occur biannually for one summer period immediately prior to earthworks (spring sampling – October to December and summer sampling February to April).

The sites sampled for aquatic macroinvertebrate monitoring will be:

Managapepeke catchment:

- EM1 at site Ea10 (control), one replicate;
- EM3 at site u/s E4 (downstream of fill 12 only during filling activity), five replicates; and
- EM2 at site E2 (downstream), one replicate.

[4] Fish monitoring is not proposed for site d/s E6 due to very low fish abundance found in previous surveys (e.g. 2 banded and 1 longfin in a 220m reach during November 2017). The natural low fish abundance at this site makes it an unreliable measure for assessing effects.

Mimi catchment:

- EM4 at site u/s Ea25 (control), one replicate;
- EM7 at site d/s E6 (downstream fill 13 only during filling activity), five replicates; and
- EM8 at site Ea26 (downstream), one replicate.

Sampling at site u/s E4 and d/s E6 will only occur during the fill activity. It is also noted that following at least one year of baseline monitoring and one year of construction monitoring, aquatic macroinvertebrate monitoring will be reduced from twice yearly (spring and summer) to annual monitoring during summer. This reduction in frequency may occur at all sites if the first year of monitoring finds only small changes in the aquatic macroinvertebrate community, e.g. a less than 20% change in QMCI or MCI compared to baseline sampling.

Aquatic macroinvertebrate surveys will use methods consistent with Protocols for sampling macroinvertebrates in wadeable streams (Stark et al. 2001). At most sites (i.e. Ea10, E2, Ea27 and Ea26) the sampling will use the semi-quantitative method for soft-bottomed streams (Protocol C2). A single replicate will be collected from stable habitat (e.g. bank margins, wood, macrophytes) sampled along a 50m to 100m reach. A consistent sampling effort will be applied at each site as described in Protocol C2. Samples from these sites will be processed using Protocol P2 – 200 Individual Fixed Count with Scan for Rare Taxa.

At the sites u/s E4 and d/s E6 sampling will use the quantitative method for hard-bottomed streams (Protocol C3).[5] Five replicates will be collected along a 50m to 100m reach from riffle habitat using a Surber sampler. These sites have gravel substrate suited to using hard-bottomed sampling protocol. Samples from these sites will be processed using Protocol P3 – full count with subsampling option.

For each site the area sampled and type of stable habitat sampled will be recorded. The following metrics will be calculated from the aquatic macroinvertebrate data: taxa richness, Macroinvertebrate Community Index (MCI), Quantitative Macroinvertebrate Community Index (QMCI), %EPT taxa and %EPT abundance. EPT (Ephemeroptera-Plecoptera-Trichoptera) metrics will exclude the species *Oxyethira* and *Paroxyethira*.

Habitat and sediment characteristics will be measured along each reach where aquatic macroinvertebrate samples are collected.

The habitat measures shall include:

- Macrophyte cover assessed using the rapid assessment protocol in the 'Regional Guidelines for Ecological Assessment of Freshwater Environments: aquatic plant cover in wadeable streams' (Collier et al. 2014). This involves assessing emergent and submerged macrophyte cover and type occupying a one metre wide belt across the stream at five transects spaced along the reach;
- Sediment cover: bankside visual estimate of percent cover, Sediment Assessment Method 1 in Clapcott et al. (2011);

[5] Quantitative sampling of aquatic macroinvertebrates is only proposed at the two sites downstream of the fill (u/sE4 and d/s E6) because these sites more sensitive and have hard-bottomed substrate. Quantitative sampling methods are more consistent and reliable for hard-bottom sites compared to the soft-bottom sites which have variable instream habitat and often lack macrophytes.

- ~~Substrate size – wolman pebble count, Sediment Assessment Method 3 in Clapcott et al. (2011); and~~
- ~~Resuspendable sediment (Shuffle Index), Sediment Assessment Method 5 in Clapcott et al. (2011).~~

8.4.4 Event based monitoring

Event-based monitoring will occur in response to an event such as heavy rainfall, exceedance of a trigger ~~(25mm of rainfall within 24 hours and/or 15mm of rainfall within 1 hour)~~ as defined in the CWMP, an unscheduled event like a failure of sediment control devices, or a chemical spill or construction accident.

Water quality monitoring during rain events and monitoring associated with chemical spills is outlined in the CWMP. The CWMP treats the whole construction site as high risk of erosion events; however, some receiving environments are more sensitive to sedimentation, in particular the kahikatea swamp forest in the Mimi catchment downstream of the tunnel portal. Additional event-based monitoring will therefore occur in this area if triggered by an event. The CWMP provides trigger values for when additional ecological monitoring will be required.

Event-based monitoring will take place (as described below) when there is:

- Risk of sediment deposition in the Mimi Swamp Forest (Mimi Stream); ~~and / or~~
- Turbidity exceedance(s) (continuous turbidity sensors);
- Major spill or leaching of contaminants.

Risk of sediment deposition in the Mimi Swamp Forest (Mimi Stream)[6]

Commented [td7]: I disagree. Aquatic macroinvertebrate sampling included below.

Trigger: 25mm of rainfall within 24 hours and/or 15mm of rainfall within 1 hour, or exceedance of management thresholds at upstream sediment retention ponds.

Monitoring action 1: Visual inspection of extent of sediment deposition in Raupo reedland and around the stream. Measure sediment deposition on sediment deposition plates. If an event causes sediment deposition greater than 6mm at any point along the line shown in Figure 8.1 and it is likely to be associated with the Project, then undertake further ecological monitoring in the Mimi swamp forest. The amount of sediment deposition shall be recorded and sediment plates shall be renewed after each event.

Monitoring action 2: The additional monitoring in the Mimi swamp forest will involve suitably qualified Project ecologists assessing the extent of any effect on the Mimi swamp forest including: visual inspection of any sediment deposition, vegetation condition survey, and fish survey. The suitably qualified ecologists shall prepare a report that includes an assessment of

[6] ~~Event based monitoring is not proposed for aquatic macroinvertebrates or fish other than that described for downstream of the Mimi Swamp Forest (Mimi Stream). This is in part because of the importance of this area, but also because sediment events are highly correlated with floods, which themselves have large natural effects on fish and macroinvertebrate communities. In the absence of closely matched control sites this makes it difficult to distinguish the effect of a sediment event from that of the flood and making it difficult to meet standard sampling criteria.~~

the overall magnitude of any effects associated with the Project on the Mimi swamp forest (ie 'negligible', 'very low', 'low', 'moderate', 'high', 'very high') and recommendations for further monitoring or remedial actions.

Aquatic macroinvertebrate sampling in response to turbidity exceedances

- Aquatic macroinvertebrate monitoring will occur in response to situations where water quality management thresholds have been exceeded for longer than 48 hours duration.
- If turbidity values at a given site(s) remain generally elevated above its respective management threshold for more than 48 hours (greater than 90% of that time), then responsive aquatic macroinvertebrate sampling (as per the methods above) will be undertaken within two working days at the relevant control and the downstream impact site(s). The downstream impact site(s) chosen for sampling, will be the site(s) closest to the discharge point. This will be determined in conjunction with TRC.
- The assessment should be undertaken by a suitably qualified and experienced freshwater ecologist, and should detail whether the following thresholds have been exceeded:
    - A decline in the QMCI score of 1.5 or more from the corresponding control site or baseline monitoring scores; and
    - A decline of greater than 20% in sensitive invertebrate taxa (in this case taxa with an MCI score of ≥5), compared with the control site or baseline monitoring scores.
- If these thresholds have been exceeded, the consent holder will undertake mitigation works, which should include sediment removal procedures (e.g., Sand WandTM [Gray 2013]) and/or additional biodiversity offsets (e.g., further riparian planting). The choice of mitigation measure(s), the quantity of mitigation, and the timeframe within which it will be implemented, will be determined in conjunction with the Ecology Review Panel and TRC.
- These mitigation responses will similarly apply to the sediment deposition monitoring of the sediment plates (at monitoring site EM5) in the kahikatea swamp maire forest.

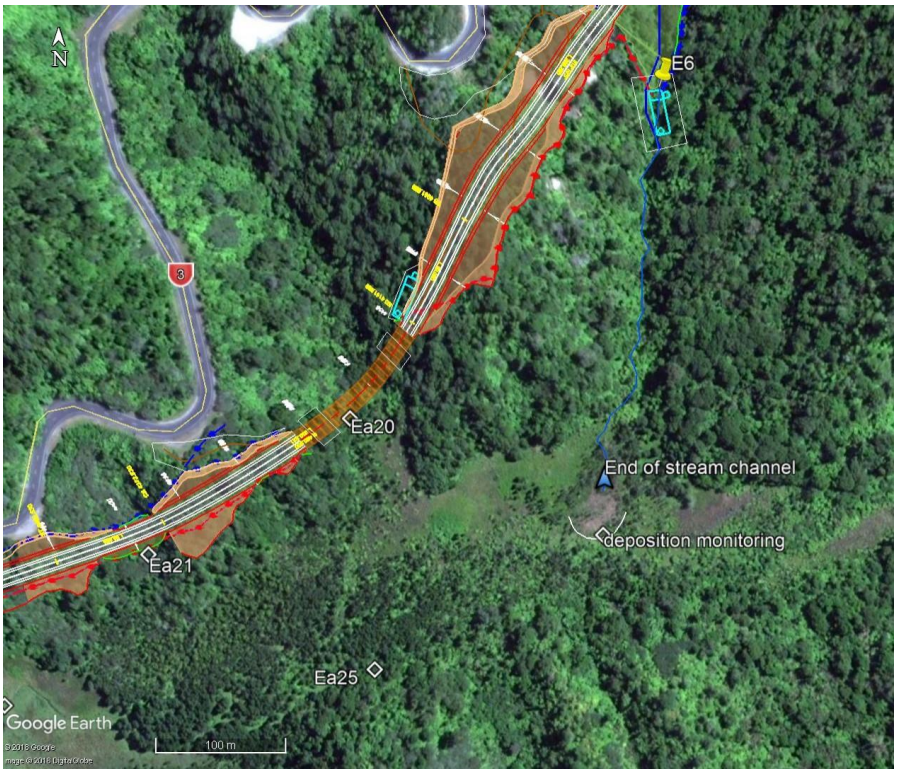

*Figure **Error! No text of specified style in document.**.1 – Location of stream channel entering raupo wetland and location of event-based sediment deposition monitoring near the northern extent of the Mimi kahikatea swamp forest*

1.1.4 Fish passage through culverts

1.1.4.1 Post construction inspection

All permanent and temporary (where feasible) culverts have been designed to provide for fish passage. Except for culverts [insert] where no fish passage is provided, All permanent culverts, and associated inlet and outlet structures, shall be inspected following their construction to ensure that they meet the design requirements to provide for fish passage. The inspection shall be done by the Project freshwater ecologist and engineer. The inspection shall assess installation and spacing of baffles or spat rope, sediment retention and water depth within the culvert, water depth over aprons and outlet structures, potential barriers in the form of shallow water, high water velocity or perches. A report shall be prepared identifying whether the culverts meet their design specification, any potential fish passage barriers and recommendations on how to rectify any potential fish passage barriers.

All permanent culvert inspections should be repeated four years after installation, to ensure the appropriate functioning of non-barrier permanent culverts

1.1.4.2 Fish passage monitoring

Actual fish passage through culverts shall be monitored at the ~~three culverts with the largest upstream catchments. These are~~following sites:

- Culvert 9 (site Ea10a) with a 67ha catchment upstream;
- Culvert 11 (site Ea12);
- Culvert 15 (site Ea16) with a 36ha catchment upstream; ~~and~~
- Culvert 17 (site Ea21); and
- ~~Culvert 15 (site Ea16) with a 36ha catchment upstream; and~~
- Culvert 18 (site Ea23) with a 25ha catchment upstream.

Fish passage monitoring will be undertaken following the methods recommended in Franklin et al. (2018). This monitoring will be undertaken annually for at least three years post-construction. ~~Fish passage monitoring will occur after peak upstream migration (August – December) upstream of culverts 9, 15 and 18 annually for two years after construction is completed. The monitoring will be used to determine if recruitment is occurring by assessing if a suitable age structure (juvenile and adult fish) is present within the fish population above culvert 9 and culvert 15.~~

Baseline fish monitoring has occurred at site Ea10a and Ea23a but has not occurred at site Ea16 due to safety constraints involving climbing a waterfall downstream of the site. Prior to the culverts being installed a fish survey will occur at site Ea16 to provide a baseline information on fish species and age structure. This may occur in association with fish recovery prior to operations.

If after 2 years the recruitment of young fish is not occurring then refinements to the culverts fish passage devices will be made to remedy any barriers to upstream fish migration.

1.2 Reporting

The specific design of any culverts (except culverts 2, 10 and 13) requiring fish passage and stream diversions will be peer reviewed and approved by an appropriately qualified freshwater ecologist at 60%, 80% and 100% project design stages. At 100% design written confirmation of the above verification will be provided to Taranaki Regional Council.

Annual freshwater ecology reporting will be completed at the end of pre-construction monitoring – baseline and at the end of each earthworks season (June) during construction. Annual reporting will be provided in memorandum format to Taranaki Regional Council (TRC) and include:

- Fish rescued as described in the FRRP;
- Location and description of culverts installed;
- Location and description of stream diversions; and
- An assessment of the overall magnitude of any effects associated with the Project on the streams (ie. 'negligible', 'very low', 'low', 'moderate', 'high', 'very high'). The assessment shall consider the effects on the stream as a whole, including spatial extent, persistence, frequency and the extent to which effects cascade through the ecosystem (e.g. effects on

Commented [td8]: Higher gradient culverts, which pose a higher risk of impeding fish passage.

Commented [td9]: Decisions like these need to be checked/certified by TRC or Ecology Review Panel.

Commented [td10]: Decisions like these need to be checked/certified by TRC or Ecology Review Panel.