







| KEY GOALS                       | PRINCIPLES   |
|---------------------------------|--|
| Prevent erosion of slope        | <ul style="list-style-type: none"> <li>This plan only shows the plan to re-establish native cover on the slope following removal of exotic species to stabilise the quarry edge.</li> <li>Pine removal will occur in late summer/ early spring and planting will occur as early as practicable in the immediately following planting season (autumn – winter).</li> <li>Pine removal will be staged to avoid exposing the entire slope in one hit. This will also help spread noise impacts of helicopter works. In Yr 2, the Anogramma / heli log area will be logged. This allows time to establish some natives under the pines prior to removal</li> <li>Plant rapidly growing, early successional plants to minimise time to achieving canopy cover. Pūriri and kawakawa will also be considered in more sheltered areas or once shelter established.</li> <li>Order plants in no larger than PB3 size (to reduce need to dig and reduce planting shock), but predominantly 0.5litre or long root trainers with well-developed roots.</li> <li>Apply grass seed (and where possible supplementary native seed e.g., kanuka / pohutukawa) to fill in gaps / achieve ground cover between plantings until plants grow enough to establish canopy cover</li> <li>Retain most privet and cotoneaster etc at the top of the scarp (area 3) until lower slope is established.</li> <li>In helicopter logging areas, where exotic shrub species will not be smashed during logging period, control privet, cotoneaster and other exotic shrub species by drill and fill so standing wood mass can provide some shelter to establishing natives while they break down.</li> </ul> |
| Restore appropriate native bush | <ul style="list-style-type: none"> <li>Start with early successional species to allow for most rapid establishment of native vegetation on the slope possible.</li> <li>There is a long term aim of establishing a Singer et al 2017 WF7 pūriri broadleaf type ecosystem via enhancement planting once sufficient plant establishment is achieved.</li> <li>Work with Biodiversity Team and Department of Conservation to confirm species list, particularly for enhancement planting stages to achieve a WF7 Pūriri broadleaf ecosystem. This plan shall be submitted for Council approval 5 years from the first planting occurring.</li> </ul>  |

| REPLANTING ZONES           |   |  |   |   |   |
|----------------------------|---|--|---|---|---|
| Zone                       |   | Approximate area                                       | Description   | Proposed control timing   | Proposed planting timing  |
| 1 - Ground-based logging   |  | 11,121m <sup>2</sup>                                   | Ground based logging will mean weedy understorey will be largely cleared. Log in late summer/ early spring and replant during the immediately following autumn-winter planting season. Stage over two years to allow for less plant availability and uncertainty over myrtle rust. Replant areas as required to compensate for losses on dry slope with shallow soil. The lower boundary is to the boundary of the depot area.  | Summer 2018   | Winter 2018   |
| 2 - Anogramma heli-logging |  | 3,073m <sup>2</sup>                                    | Will under-plant prior to logging to ensure slope is protected. Plantings will consider long term maintenance of suitable <i>Anogramma</i> habitat –Tūpuna Maunga Staff will seek advice from Auckland Council Biodiversity threatened plants staff and Department of Conservation staff.   | Summer 2019   | <ul style="list-style-type: none"> <li>Underplanting winter 2018</li> <li>Supplementary planting following logging winter 2019</li> </ul>     |
| 3 - Privet edge            |  | 3,701m <sup>2</sup>                                    | Retain privet and other weedy shrub species (although control tree privet by drill and fill in situ prior to it reaching 4m in height as it will put pressure on the top of the slope if it gets too tall) for safety, erosion protection and visual amenity until vegetation on lower slope is established. Replant with harakeke to provide a safety barrier at the top of the slope, a good edge that will prevent weed invasion into native bush area, and possible as required.  | Summer 2021   | Winter 2021   |
| 4 - Non-logging area       |  | Upper 4,226m <sup>2</sup><br>Lower 2,887m <sup>2</sup> | The soil in this area appears to have been too thin for pines to survive, particularly in the upper area. The lower area consists primarily of tree privet. Scattered privet and other weeds interspersed through rank kikuyu and perennial exotic species dominate the edges and upper area. May be some potential <i>Anogramma</i> habitat near the top of the slope? Lower area has sufficient soil depth for planting. Due to shallow soil, removal of weeds to allow gradual natural colonisation by natives may be the best option in the upper area. | Gradually due to limited soil depth. (It may never be possible to establish canopy in some areas) | <ul style="list-style-type: none"> <li>In lower area, the first winter after the tree privet is removed or thinned (no pines here)</li> </ul> |

**Approximate timeline to show general progression of site establishment**

| <b>Approximate date</b> | <b>Zone 1 (ground based logging)</b>  | <b>Zone 2 (heli-logging)</b>  | <b>Zone 3 (privet edge)</b>   | <b>Zone 4 (non-logging area)</b>  |
|-------------------------|---|---|---|---|
| Summer 2018             | Log as much of this zone as we can replant this winter, given plant availability                    |   | Leave for stability and safety (drill and fill any larger tree privet before they get too big, but leave the bulk of it in place)   | Privet removal and stump cut on lower slope area only –leave all vegetation on upper slope  |
| Winter 2018             | Plant areas logged in summer  | Under plant while pines still there to provide shelter  | Largely leave for stability and safety until slope below establishing   | Staged replanting of lower area as per zone 1 (as lower slope in Zone 4 has soil), possibly with Corrections.   |
| Summer 2019             | Plant maintenance year 1a (i.e., first area being planted)<br>Log remaining area                    | Heli log area   | Largely leave for stability and safety until slope below establishing   | Limited control to get rid of worst weeds on the upper slope area plus maintenance of lower area  |
| Winter 2019             | Plant remaining area  | Plant   | Largely leave for stability and safety until slope below establishing   | Continue as per winter 2018   |
| Summer 2020             | Plant maintenance year 1b (i.e., first year of plant maintenance that covers the full planted area) | Ropes access maintenance (yr1)  | Largely leave for stability and safety until slope below establishing   | Continue as per summer 2019   |
| Winter 2020             | Plant maintenance year 1b cont, plus infill planting if required                                    | Do not disturb area while <i>Anogramma</i> is active (unless infill planting required)  | Largely leave for stability and safety until slope below establishing   | Continue as per winter 2018   |
| Summer 2021             | Plant maintenance year 2  | Ropes access maintenance (yr2)  | Start to clear some areas where natives have established below  | Continue as per summer 2019   |
| Winter 2021             | Plant maintenance year 2 cont, plus infill planting if required                                     | Do not disturb area while <i>Anogramma</i> is active (unless infill planting required)  | Plant densely up to 2m from the edge with flax and other species suitable for archaeological sites  | Continue as per winter 2018   |
| Summer 2022             | Plant maintenance yr3   | Ropes access maintenance (yr3)  | Continue to clear areas where natives have established below  | Continue as per summer 2019   |
| Winter 2022             | Plant maintenance yr3 cont, plus infill planting if required  | Do not disturb area while <i>Anogramma</i> is active (unless infill planting required)  | Plant densely up to 2m from the edge with flax and other species suitable for archaeological sites  | Continue as per winter 2018   |
| Summer 2023             | Plant maintenance yr4   | Ropes access maintenance (yr4)  |   | Continue as per summer 2019   |
| Winter 2023             | Plant maintenance yr4 cont, plus infill planting if required  | Do not disturb area while <i>Anogramma</i> is active (unless infill planting required)  |   | Continue as per winter 2018   |
| Summer 2024             | Plant maintenance yr5   | Ropes access maintenance (yr5)  |   | Continue as per summer 2019   |
| Winter 2024             | Plant maintenance yr5 cont, plus infill planting if required  | Do not disturb area while <i>Anogramma</i> is active (unless infill planting required)  |   | Continue as per winter 2018   |
| <i>Future</i>           | <i>WF7 Pūriri-broadleaf vegetation type (Singer et al 2017)</i>                                     | <i>WF7 Pūriri-broadleaf (Singer et al 2017), and / or currently extinct tihī vegetation type (as indicated by Horrocks et al)</i> | <i>Flax edge or currently extinct tihī vegetation type (as indicated by Horrocks et al), using low-growing species that will maintain historic defensive view shafts and shallow-rooted species suitable for archaeological areas</i> | <i>Native cover that can survive on very shallow soils on exposed slopes, particularly in upper area. WF7 and / or potential cultural harvest species in the more accessible and deeper-soil area on the lower area</i> |

| <b>METHODOLOGY TO ADDRESS SITE DIFFICULTIES</b> |   |
|---|---|
| <b>Issue</b>                                    | <b>Methods to address issue</b>   |
| Slope erosion following logging                 | <ul style="list-style-type: none"> <li>• Re-plant with natives the planting season immediately following logging. This may involve staging if plants cannot be secured for the entire site for the immediately following planting season, but areas should not be left in grass seed for 12-18 months.</li> <li>• Where other woody vegetation is present (e.g., Cotoneaster / privet) this should be controlled by drill and fill and not removed from site. This will mean roots remain in the soil while native plants are establishing and the woody tops provide some shelter, but the tops do not shade out young natives while they are establishing.</li> <li>• In areas where there is a thick kikuyu cover (western slope area between privet) this should be sprayed out, with an initial spray no later than Feb / March to ensure a good kill rate, but left on site as it will provide good mulch for the first winter as it dies down.</li> <li>• Areas not containing kikuyu should have grass seed applied between plants to provide soil cover while native plants are establishing.</li> <li>• Exotic shrub areas around the edges of the logging area should be retained until natives are established in the logged area.</li> </ul> |
| Soil profile                                    | <ul style="list-style-type: none"> <li>• Soil depth assessed as being sufficient to plant root trainer grade.</li> <li>• Recommend ½ litre size, which have a stronger root depth (approx. 15cm) than standard root trainers (which will increase survival rates), but still don't need a deep hole dug (which would increase potential erosion during planting)</li> <li>• Add 'crystal rain' and fertiliser tablets when planting</li> <li>• Allow provision for replanting in the contract<sup>1</sup></li> </ul>  |
| Exposure  | <ul style="list-style-type: none"> <li>• Planting (not hydro-seeding; hydro-seeding natives has variable success rates –planting is a more reliable way to ensure plant survival)</li> <li>• Hand sow grass seed or another ground cover between plants after planting. This will reduce soil drying the following summer, as well as reduce weed germination / competition from weeds. (Hydro seeding would be difficult as would either break up the hydro-seeded material while planting if hydro-seeding was carried out prior to planting, or smother plants if hydro-seeding was done after planting.)</li> <li>• Plant early in the planting season so plants have the whole wet season to establish prior to the summer dry period.</li> <li>• Allow provision for replanting in the contract</li> <li>• Plant more robust species first and less robust species as infill to replace trees that don't survive once some shelter has established around them.</li> <li>• In autumn 2018 only log an area sufficient to plant around 5,000 trees in winter 2018 to allow species and methodologies to be tested and adjusted as required to achieve maximum possible survival rates.</li> </ul>  |
| Sourcing suitable plants for winter 2018        | <ul style="list-style-type: none"> <li>• There is some risk that we may not be able to source all of the required plants species in the 2018 period.</li> <li>• If this is the case, we will not log any areas on the quarry slope that we can't replant that same winter.</li> </ul>   |
| Slower growth rate                              | <ul style="list-style-type: none"> <li>• Normally we would calculate on approximately 1m growth per year. On this site, we are calculating an average growth of 0.5m per year. We will therefore need a longer maintenance period (to stop competition from weeds overtaking the native planting). Usual maintenance period to allow for canopy closure is three years; we are calculating on a five year maintenance period. We would accept a resource consent condition that requires maintenance until canopy closure.</li> </ul>   |

<sup>1</sup> Allow for a baseline non-survival rate of 10% that will require infill / replacement planting, plus have contingency funding for infill planting to replace a further 10% non-survival (total of 20% non-survival).

## Approximate species list for initial planting

NB: The ultimate goal of planting is to establish a Singer et al (2017) WF7 Pūriri-broadleaf forest type, with possibly influences from Horrocks nearer to tihi. This, however, will take many years to achieve. The initial requirement is to rapidly establish native cover to ensure slope stability, using early successional species that may include species from the list below. In winter 2018 in particular, quantities and exact species composition will depend on availability of good quality stock. Species list may also get modified depending on advice from Biodiversity team and Department of Conservation specialists, supplier recommendations, and updates in vulnerability of native Myrtaceae species to myrtle rust. Species list in the second and subsequent years likely to change based on performance of species planted on this site in year 1. Low growing species will be planted on upper growing slopes to protect defensive sightlines.

\*\*\* = plant most

\*\* = plant moderately

\* = plant sparsely

| SPECIES                                       | QUANTITY | INITIAL (A) or INFILL (B) - areas 1 and 2 | BENEFITS   | POTENTIAL ISSUES  | PLANTING ZONES |
|---|----------|---|--|---|----------------|
| Kanuka  | ***      | A   | Good root tensile strength   | Myrtle rust (although kanuka currently appears to be less vulnerable) and availability (e.g., large loss at prison –likely to be a shortage of eco-sourced material in year 1)  | 1              |
| Coprosma robusta & C. macrocarpa subsp. minor | ***      | A   | Demonstrable suitability to the site because it's one of the few native species that has self-established there. Lower growing than other primary colonising species, so good for upper slopes.  |   | 1              |
| Whau  | **       | B   | Fast growing with large leaves creating rapid site coverage  | Short lived –don't plant as a monoculture –mix with other species   | 1              |
| Flax  | **       | B   | Good for edge areas; forms a dense barrier against weed invasion. Also good to form a safety barrier top side of slope.  | No canopy creation –only for use around the edges, especially low growing areas around upper areas to maintain defensive sightlines   | 4, 1 (edges)   |
| Kawakawa                                      | *        | B   | Fast growing / rapid site coverage when self-seeded.   | May struggle initially in more exposed areas. A bit lacking in seed source though, so looking to establish some.  | 4, 1 (edges)   |
| Pohutukawa                                    | *        | A   | Adapted to exposed cliff areas   | Myrtle rust –looks moderately vulnerable –don't plant large areas in case it doesn't survive.   | 1, 2,          |
| Metrosideros perforata / white rata           | *        | B   | Ground cover that might work on more exposed areas with limited soil depth. Might work well on non-logging area and top of heli-log area.  | Myrtle rust –no idea of vulnerability to this yet   | 2, 3, 4        |
| Haloragus                                     | *        | B   | Good early successional / disturbance native groundcover –no local seed source on Maungarei / Mt Wellington, so may plant just enough to establish this and see how it goes on its own. Research by RIMU indicates it competes OK with kikuyu. | Doesn't form dense cover. Unsure of how well it goes on shallow soils.  | 4, 3           |
| Mheulenbeckia australis                       | **       | B   | Ground cover that might work on more exposed areas with limited soil depth. RIMU research indicates it competes OK with kikuyu. Might work well in non-logging area.   |   | 4, 2, 3        |
| Totara  | *        | B   | Grows well on Batger Quarry, Maungawhau / Mt Eden  | Probably won't work in shallow soil areas   | 1 (edges)      |
| Pūriri  | *        | B   | Key component of WF7 broadleaf and kind of an early successional species   | Needs a bit of shelter to get going, so for initial plantings would only work on edges underneath ledges on western-most area of the ground-based logging zone. (More could be added in enhancement plantings in future years.) | 1 (edges)      |
| Mahoe   | ***      | A   | Early successional, fast growing, good root structure  | Will struggle on upper slopes –keep to lower areas.   | 1              |
| Cabbage trees                                 | *        | B   |  |   | 1              |

|                      |    |   |  |   |                |
|----------------------|----|---|--|---|----------------|
| Kaupaka (Griselinia) | *  | B | Apparently OK on marginal soil and a distinctive component of WF7  | Enhancement only? (Not sure how it goes without shelter)  | 1 (plus 2,3,4) |
| Karo                 | ** | A | Very hardy. Existing karo has self naturalised here = can survive on slope, so a good component of early planting. | A little far inland –usually recommended for more coastal plantings (but going to use some anyway as this is a difficult site). | Mainly 1       |