



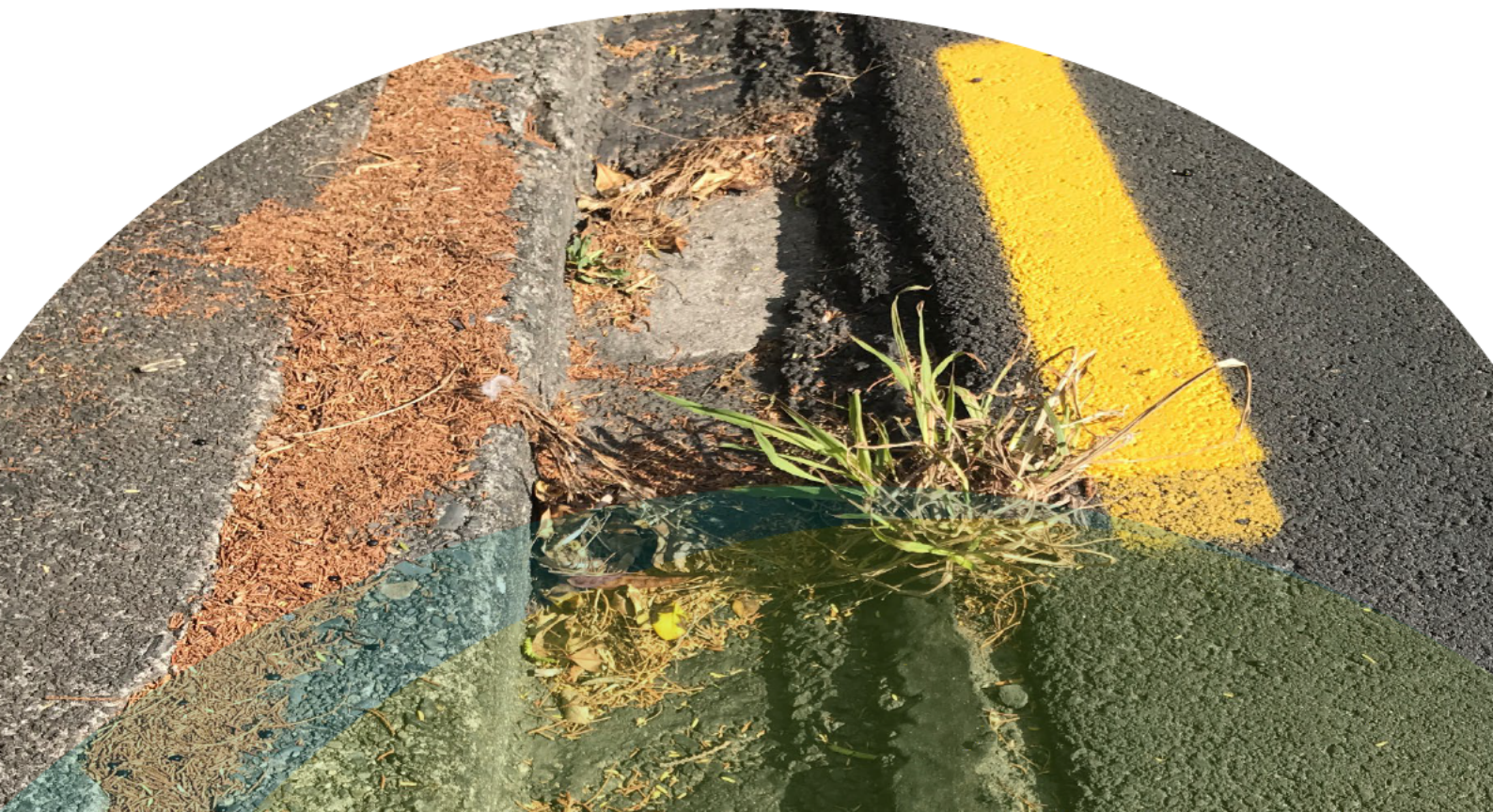
Co-creating a thriving ecosystem

Weed Management in the Urban Road Corridor

Options Analysis Report

Final

Prepared for Auckland Council



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Executive Summary

Auckland Transport (AT) manages and controls the Auckland Transport System and determines required service levels and budget allocation for weed management in the road corridor. Auckland Council's (AC) Community Facilities department undertakes management of weeds on hard surfaces and edges, in the urban road corridor on behalf of Auckland Transport, through council's full facilities contracts. The method and cost of meeting the contract specification varies across Auckland's local boards.

Auckland Council conducted a regional review of how weeds are managed in the urban environment culminating in a resolution by the Environment and Climate Change Committee in 2020, to select a standardised approach to urban weed management in Tāmaki Makaurau to address regional inconsistencies in control methods and funding.

Morphum Environmental Ltd (Morphum) were engaged by Auckland Council to provide an independent assessment of weed management to inform the selection of a single regional method against which a standardised funding model could be applied. The scope required that the selected method satisfy relevant policies including Auckland Council's Weed Management Policy; Auckland Water Strategy (2022-2050); and Te Tāruke-Ā-Tāwhiri: Auckland's Climate Plan and several key objectives, notably:

Meet the objectives of Auckland Council's Weed Management Policy and the goal of further minimising glyphosate usage, limiting environmental impact, ensuring public health and safety and reducing carbon emissions, and potable water use.

A long list of potential options, including emerging technologies were canvassed from contemporary scientific journals. From the long list of 24 options covered under 5 broad types of method (including combinations of single methods), the following shortlist was selected for a detailed options analysis based on efficacy, scalability and ability to meet the control standard:

- Glyphosate
- Organic Herbicide
- Mechanical
- Thermal (Hot water or Steam)
- Combo 1: Glyphosate and organic herbicide
- Combo 2: Glyphosate, organic herbicide and thermal
- Combo 3: Glyphosate and mechanical
- Combo 4: Glyphosate and thermal
- Combo 5: Zero Chemical (mechanical and thermal)
- Combo 6: Organic herbicide, thermal and mechanical

The scope provided by Auckland Council required the consideration of the factors in undertaking the options analysis:

- Operator Health and Safety
- Public Health and Safety

- CO_{2e} Emissions
- Water Usage
- Cost
- Potential Risk to Freshwater Environment

The ranking from the comparative analysis is summarized in Table 1. The results draw from the combined ranking across the individual criteria in the subsequent table. The detailed methods for quantifying the risk/impact within each criteria are provided in the report, but it is worth noting the following in considering the results:

- Certain methods are more suitable in specific contexts than others due to the sensitivity of the social or environmental context, practical considerations, and ultimately what option will be effective with available budget. It is not possible to account for these variables in a regional assessment. The assessment has therefore been conducted on a per/km basis.
- The colours support visual impression of the ranking of methods relative to the other methods for the assessment criteria. They do not represent the magnitude of the impact or risk rating.
- There is no weighting of the criteria.

Table 1: Combined score based on the ranking across all the factors assessed in the options analysis. No weighting has been applied to any of the factors assessed.

<u>Weed Management Option</u>	<u>Combined Score</u>	<u>Overall Ranking</u>
Glyphosate	18	1
Mechanical tools	23	2
Combo 3: Glyphosate and Mechanical	24	3
Combo 1: Glyphosate + Organic Herbicide	25	4
Organic herbicide	28	5
Combo 2: Glyphosate, organic herbicide and thermal	29	6
Combo 4: Glyphosate and thermal	31	7
Thermal (Hot water or Steam)	33	8
Combo 5: Zero Chemical (Mechanical and thermal only)	35	9
Combo 6: Organic herbicide, thermal and mechanical	37	10

<u>Method</u>	<u>Overall</u>	<u>Emissions</u>	<u>Water</u>	<u>Freshwater Risk</u>	<u>Operator H&S</u>	<u>Public HS</u>	<u>Cost</u>
Glysohate	1	3	3	6	2	2	1
Organic herbicide	5	4	5	10	1	4	3
Mechanical- tool- weedwhackers	2	1	1	1	2	7	10
Thermal (Hot water or Steam)	8	10	10	1	2	1	8
Combo 1: Glysohate + Organic Herbicide	4	4	4	9	2	4	2
Combo 2: Glyphosate, organic herbicide and thermal	6	6	6	7	2	4	4
Combo 3: Glyphosate and Mechanical	3	2	2	4	2	7	7
Combo 4: Glyphosate and thermal	7	9	9	4	2	2	5
Combo 5: Zero Chemical (Mechanical and thermal only)	9	8	8	1	2	7	9
Combo 6: Organic herbicide, thermal and mechanical	10	7	7	8	2	7	6

Based on the factors assessed, glyphosate as a standalone weed management method received the best overall ranking given it is the most effective and consequently requires the least applications/annum and it is significantly cheaper than any other method. It also has relatively low water use and emissions compared with the thermal options. However, given that the reduction of total glyphosate usage is one of the primary objectives of the Climate Change Committee resolution that informed the assessment, it is not an acceptable single option. It is also worth noting that, while cultural preferences¹ were not included in the options analysis, feedback from Iwi in the pre-2020 investigations supported reduced use of glyphosate.

Mechanical methods ranked second overall as they scored well for all criteria, barring two. Public health and safety, which was still ranked as being of low significance, but higher than all other methods. Secondly, due to the labour-intensive nature of this method, the cost is effectively prohibitive as a single solution, coming in at approximately 10 times more expensive than Glyphosate S 7(2)(b)(i) Prequ /km compared with \$ S 7(2)(b) /km).

A combination of Glyphosate and mechanical methods score third based on their strengths noted above, but this option remains extremely costly compared with a glyphosate only option ((S 7(2)(b)(i) F /km compared with \$ S 7(2)(b) /km).

The combination of glyphosate and organic herbicide ranks fourth as it is in the top four for all criteria. The main shortcoming is the potential risk to receiving freshwater environments.

All the options that involve thermal methods have significantly high impacts in terms of water use, generation of emissions (due to the generation of heat as a basis for the method, and vehicles required), and consequently don't support the council policy in terms of climate change objectives and targets and water efficiency. They are also very costly (2 or more times more expensive than the Glyphosate/Organic herbicide combination) and are likely to require traffic management.

On the balance of criteria and the objectives established by the resolution of the climate change committee, the combination of organic herbicide and glyphosate emerges as the most appropriate option. It will reduce glyphosate usage across Auckland with the largest local board areas in the South and the West. Water usage, CO_{2e} emissions are also far lower than any of the thermal options and it has the second lowest per/km cost.

In the absence of the broader investigation identifying any new methods for inclusion in the options analysis, and Morphum undertaking an independent review based on updated information, it is worth noting that the conclusion regarding the most suitable method i.e., combination method of organic herbicide and glyphosate, aligns with conclusion and recommendation of the preceding investigation.

Seven recommendations have been provided to support improved understanding and ongoing progress towards best practice.

1. Enforcement and monitoring of contractor spraying programmes to ensure runoff potential for chemical treatment methods are reduced. This includes both wind and having clear weather windows where predicted precipitation is less than five millimetres within a six-hour period.
2. Iwi preferences did not inform the options despite the Council's efforts in this regard. Iwi did however indicate that the draft recommendations be presented to them for comment before circulation to local boards. Given that consideration of cultural perspectives was a specific

¹ Responsibility for engaging Iwi, sat with Auckland Council. While a certain level of engagement did take place, and various attempts were made to engage Iwi, this did not include direct scoring of the methods by Iwi.

requirement of the Climate Change Committee resolution, and the required level of input was not received, it is recommended that this report is presented to mana whenua, as per their expectation.

3. Continuous investigation into organic and synthetic herbicides as new products enter the market. Should a viable option be developed, that will meet the contractual specifications, policies and legal frameworks and be scientifically proven to be less eco-toxic than current organic and synthetic herbicides then it should be implemented.
4. Improved consideration or better alignment with other interventions, notably street sweeping, to reduce the leaf and sediment build up that supports weed growth.
5. Maintain curb and pavement renewal programmes to minimise sites (cracks) for weeds to establish.
6. Broader public education on the use herbicides and communication that both organic and synthetic as both have adverse effects on receiving environments.
7. Understanding the environmental concentration of herbicides within Auckland's waterways would assist in confirming the nature and scale of the impact of chemical weed management on receiving freshwater environments, and support broader public awareness described in the preceding point.

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1. Introduction

Auckland Council has engaged Morphum Environmental Ltd (Morphum) to support the Council's Community Facilities team, via an independent investigation and options analysis, to identify a single regional method for managing weed species in the urban road corridor across Tāmaki Makaurau. This section introduces the project background as context to the approach to the investigation, comparative analysis of options, and associated recommendations.

1.1. Background

Auckland Transport (AT) manages and controls the Auckland Transport System and determines required service levels and budget allocation for weed management in the road corridor. Auckland Council's (AC) Community Facilities department undertakes management of weeds on hard surfaces and edges, in the urban road corridor on behalf of AT, through council's full facilities contracts.

The primary purpose of weed management is to reduce maintenance of roading surface including footpaths and curb channel. The service level and outcomes for weed management across 5,055km of the urban road corridor is consistent across Auckland. The specification requires that the following seven contract outcomes, and supporting performance and technical and management outcomes are achieved.

1. Road corridors are safe and aesthetically pleasing and asset life is not compromised by weed management.
2. Weeds do not damage road surfaces or road assets.
3. Weeds do not impede the flow of drainage water.
4. Town centres are tidy, well-maintained, and aesthetically pleasing.
5. Industry standards, legislative requirements and Auckland Council Plans and Policies are adhered to.
6. Agreed sustainability and environmental innovation targets are implemented.
7. Supplier adopts and implements environmentally sustainable treatment methodologies (where practicable and without compromising methodology effectiveness).

While the contract outcomes are consistent across the region, the current methodology and expenditure per kilometre for meeting the contract varies as summarized below, reflecting the continuation of legacy council approaches.

The spatial application of different weed management methods employed across urban roading network is shown in Figure 1 and includes a combination of the following methodologies:

- Synthetic herbicides (glyphosate)
- Organic herbicides (organic herbicide)
- Thermal (hot water/steam)
- Mechanical (weed trimmers)

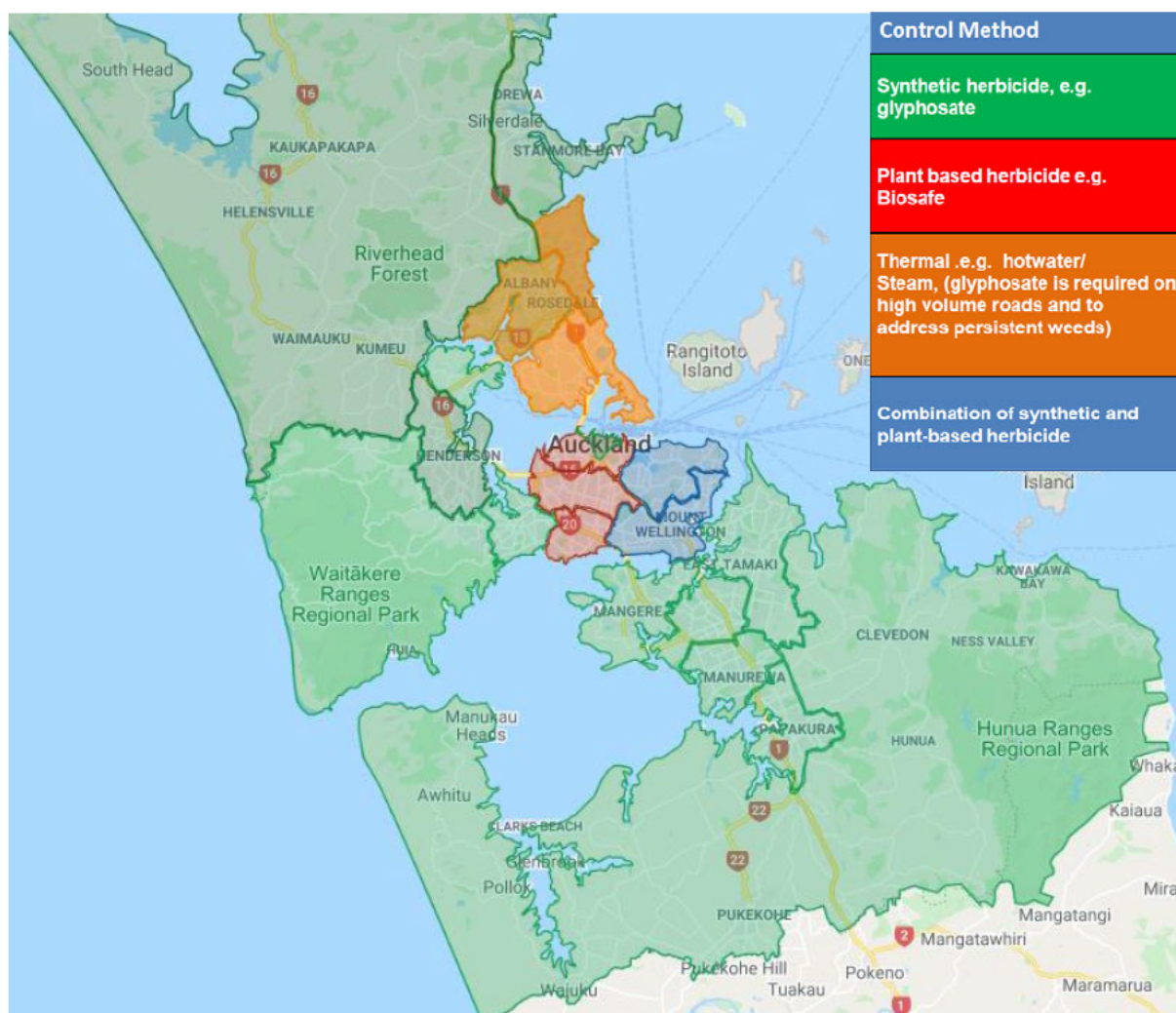


Figure 1: Graphic of the current methodologies used by the relative local boards (Auckland Council, 2020).

As shown in Figure 1, Glyphosate is the primary weed control method employed by local boards currently in the rural regions of Auckland. The North Shore regions employ only thermal techniques, while the other urban regions of Auckland use plant based, or a combination of plant based and glyphosate methods for weed control.

1.2. Policy and Legislative Framework

The contract specification gives effect to the intent and requirements of the broader policy and legislative framework summarized in (Appendix 1), most notably the Auckland Weed Management Policy which has the following objective and guiding principles:

Objective: Working together to reduce the adverse effects of weeds and their management on people and the environment.

- Take an integrated approach to weed management and vegetation control.
- Ensure best practice in weed management and vegetation control.
- Minimise agrichemical use.

- Minimise non target effects of agrichemical use.
- Ensure public health and safety.
- Protect and enhance the environment.
- Empower the community to manage weeds under the policy.
- Deliver weed management and vegetation control which is value for money.

Other key policy and legislative instruments are summarized below. Links to these documents and the specific requirements of relevance to weed management are provided in Table 2. The ability of the selected regional method to give effect to the Council Weed Management and these other relevant policies is one of the specific requirements of the Council review and resolution discussed in Section 1.3.

- Auckland Water Efficiency strategy 2020.
- Auckland Climate Action Plan
- Environmental Protection Authority
 - Regulates Hazardous Substances
 - Allow the use of hazardous substances subject to controls.
 - Code of Practice (NZS 8409:2004 Management of Agrichemicals)
- Auckland Unitary Plan
 - Sets further requirements around who can apply agrichemicals and how.
- Contractors and Contract Management
 - Reinforce Best practice and the conditions of the contract.

Table 2: Policies and legislation pertaining to weed management in the urban corridor.

Reference	Summary of Objectives/Requirements
Auckland Council Weed Management Policy 2013	<p>The Weed Management Policy promotes methods that have the least potential for adverse effects. The policy has eight objectives:</p> <ol style="list-style-type: none"> 1. Take an integrated approach to weed management and vegetation control. 2. Ensure best practice in weed management and vegetation control. 3. Minimise agrichemical use. 4. Minimise non-target effects of agrichemical use. 5. Ensure public health and safety. 6. Protect and enhance the environment. 7. Empower the community to manage weeds under the policy. 8. Deliver weed management and vegetation control which is value for money.
Policy	Auckland Regional Pest Management Plan 2020-2030
	<p>The Auckland Council has a regional leadership role under the Biosecurity Act 1993 (the Biosecurity Act). The purpose of the RPMP is to outline the framework to efficiently and effectively manage or eradicate specified organisms in the Tāmaki Makaurau / Auckland region. Doing so will:</p> <ul style="list-style-type: none"> • minimise the actual or potential adverse or unintended effects associated with those organisms; and • maximise the effectiveness of individual actions in managing pests through a regionally coordinated approach.
	Auckland's Climate Plan
	<p>There are two primary goals of Auckland's Climate Action Plan. Weed management is said to contribute up to 5% of Auckland Council's total emissions annually.</p> <ol style="list-style-type: none"> 1. 1. to reduce our greenhouse gas emissions by 50 per cent by 2030 and achieve net zero emissions by 2050. 2. 2. to adapt to the impacts of climate change by ensuring we plan for the changes we face under our current emissions pathway.
	Auckland Water Strategy 2022-2050
	<p>The vision for Auckland; s Water Strategy involves the following six objectives with number four the most pertinent for weed management in the urban corridor:</p> <ol style="list-style-type: none"> 3. see a stronger partnership approach from the council with mana whenua. 4. know that the council is prioritising water ecosystem wellbeing (mauri) in its decisions. 5. be empowered to contribute to decision and action that drive wellbeing of water and people. 6. be more efficient water users. 7. have greater access to blue-green spaces at local and regional levels. 8. experience more places that celebrate water as foundational to place-making.

	<p>Biosecurity Act 1993.</p>	<p>A regional council provides leadership in activities that prevent, reduce, or eliminate adverse effects from harmful organisms that are present in New Zealand (pest management) in its region. This Act informs the Auckland's Regional Pest Management Plan with the aim to reduce/control invasive species including weeds.</p>
<p>Legislation</p>	<p>Auckland Unitary Plan: Chapter E Auckland Wide → Section 34: Agrichemicals and vertebrate toxic agents.</p>	<p>E43.3 Policy Avoid significant adverse effects, and minimise other adverse effects on the environment from the use of agrichemicals and vertebrate toxic agents including off-target spray drift, handling, storage, transport or disposal by all of the following:</p> <ul style="list-style-type: none"> • (a) managing their application to prevent adverse effects on or near sensitive areas; • (b) using where practicable, the least toxic and volatile agrichemical or vertebrate toxic agents with the most harmless adjuvant (substance used to improve their performance) suitable for the purpose; • (c) applying agrichemicals and vertebrate toxic agents in accordance with the product's label, including specified rates of application; • (d) using an application method that minimises spray drift, giving particular attention to all of the following: (i) type of spray equipment used; (ii) spray volume and droplet size; (iii) direction of spraying; (iv) height of release above the ground; (v) weather conditions; (vi) proximity to sensitive areas; and (vii) separation distances; and • (e) considering the benefits and costs of alternatives to the use of agrichemicals and vertebrate toxic agents for plant and animal protection.
	<p>Resource Management Act 1991.</p>	<p>The purpose of this Act is to promote the sustainable management of natural and physical resources. The RMA 1991 sets the high level guidance for managing New Zealand's resources from which the AUP was developed.</p>
<p>Best Practice Standards</p>	<p>New Zealand Standard – Management of Agrichemicals (NZS 8409: 2021)</p> <p>ISO14001 (Environmental Management System)</p> <p>ISO45001 (Occupational Health and Safety Management System)</p>	<p>Contractors are required to follow and have the NZS 8409: 2004 accreditation under the AUP. → "Objective of this standard is to provide practical and specific guidance on the safe, responsible and effective management of agrichemicals, including plant protection products (such as herbicides, insecticides, fungicides), veterinary medicines, fumigants used in rural situations and agricultural use. A number of updates have been included in this revision including expanding off-label guidelines to align with current industry practice, including new technologies such as UAVs and drones, and reflecting recent changes to legislation and an updated classification system for hazardous substances."</p> <p>ISO14001 accreditation is the standards for developing and implementing an Environmental Management System (EMS) for business operations. The majority of contractors will have this accreditation.</p> <p>ISO45001 accreditation is the standards for developing and implementing Occupational Health and Safety Management Systems (OHSMS).</p> <p>Implementing an OHSMS enables an organization to:</p> <ul style="list-style-type: none"> • Protect its workforce and others under its control

-
- Comply with legal requirements
 - Facilitate continual improvement
-

[GROWSAFE](#) certification or equivalent

Certifications involve contractor training in the use of highly eco-toxic agrichemicals and training relating to the NZS:8409. Certifications such as GROWSAFE must be listed as acceptable accreditations by the NZ EPA.

[Land Transport Rule: Dangerous Goods 2005](#)

Some Agrichemicals are listed as dangerous goods and are therefore subject to the Land Transport Rules around dangerous goods. → "The **Land Transport Rule: Dangerous Goods 2005** sets out the requirements for the safe transport of dangerous goods on land in New Zealand. The Rule covers the packaging, identification, and documentation of dangerous goods; the segregation of incompatible goods; transport procedures and the training and responsibilities of those involved in the transport of dangerous goods. The Rule's requirements are applied according to the nature, quantity and use of the goods."

[NZTA's Code of Practice for Temporary Traffic Management \(COP/TTM\)](#)

The regulations around traffic management that will be required for contractors undertaking works in the roading corridors for weed management. The level of traffic management will depend on the roading class.

1.3. Regional Weed Management Review

A process commenced in 2015 towards consistency in methodology and funding as summarized below, which included the commission of specialist investigation, considerable research and engagement with local boards, Mana Whenua, and best practice reference groups (Figure 2).



Figure 2: Regional Review of weed management methodologies process.

The process culminated in a resolution of the Environment and Climate Change Committee to create a standardised approach to urban weed management in Tāmaki Makaurau. The following nine objectives produced by the Environment and Climate Change Committee Resolution inform the decision-making framework for creating the standardised approach.

1. Auckland Transport manages and controls the Auckland Transport System and determines required service levels and budget allocation for weed management in the road corridor.
2. Auckland Council's Community Facilities department undertakes management of weeds on hard surfaces and edges, in the urban road corridor on behalf of Auckland Transport, through council's full facilities contracts.
3. The service level and outcomes for weed management across 5,055km of the urban road corridor is consistent across Auckland, however the methodology and expenditure per kilometre varies, reflecting the continuation of legacy council approaches.
4. As a matter of priority, **engagement and consultation with all mana whenua**, the Mana Whenua Kaitiaki Forum and the Independent Māori Statutory Board for the consideration of this committee in the decision-making process.
5. Meet the objectives of Auckland Council's Weed Management Policy and the goal of further **minimising glyphosate** usage, **environmental impact**, ensuring **public health and safety** and **reducing** carbon **emissions**.

6. **Standardise funding per kilometre** within the existing regional allocation budgets to maintain service levels for weed management in the road corridor for each Local Board area consistent with the Weed Management Policy.
7. **Allow for customised local methodologies within the standardised funding envelope.** with Community Facilities working with local boards to agree a funding mechanism by March 2022 otherwise the local boards will have to work within the standardised funding model.
8. Community Facilities continue to **investigate and prioritise weed management options** that include; **non-agrichechemical** methodologies, the **use of zero or low emission vehicles** and **non-potable water.**
9. **Should new methodologies or technology become available** that meet the criteria outlined in the aforementioned objectives, it is implemented with Auckland Transport approval.

2. Approach

To implement the committee's resolution required Community Facilities to:

1. Re-engage with Mana Whenua on their preferences for weed management in the urban road corridor.
2. Investigate the emergence of any new methods, and running a comparative analysis to confirm the most appropriate in terms of the objectives laid out in the resolution i.e. water efficient, low carbon output, culturally acceptable, reduced use of chemicals, etc.
3. Running a procurement process to confirm pricing for various options.
4. Presenting the findings and recommendations to Mana Whenua and Local Boards.

Morphum were appointed to cover the second point above. The responsibility for engaging Mana Whenua and securing updated costings for the shortlisted options is the responsibility of AC Community Facilities.

In the interest of a robust and independent review, Morphum's has applied the follow approach:

- Develop a long list of potential options. The aim of this was to establish if there are any additional technologies that warranted consideration. This investigation was based on literature review.
- Refinement of the long list to a shortlist of options based on engagement with a leading academic² and contractors³ to confirm ensure the efficacy of the proposed options.
- Undertake a comparative analysis of the shortlist against several key objectives, and constraints.
- Development of recommendations to support improved practice and sustainability performance against the key criteria (reduced emission, water efficiency, human health and safety and environmental protection).

² Associate Professor Kerry Harrington, 31/08/2021

³ Landscape Solutions Ltd., 06/09/2021

3. Assumptions and Limitations

The investigation and analysis should be read with the following assumptions and limitations in mind:

- Mana Whenua perspective – the responsibility for securing feedback on the preferred methods in relation cultural priorities is the responsibility of Auckland Council. Considerable effort was attributed to this need by Auckland Council (see log of communications and engagement supplied by Auckland Council – Appendix 2). Morphum supported Auckland Council in attending the regional engagements, post which Morphum proposed having working session with Mana Whenua to explain the options and receive their comments, preference and reasoning. Despite the significant effort post these engagements no substantive input was received that provides any additional view on the preference of Mana Whenua, beyond the feedback received in previous engagement prior to the resolution of the Climate Change Committee discussed in Section 1.3.
- An Auckland Transport trial of the Waipuna foam steam system was undertaken in 2020. The results of the trial indicated that foam residues were entering the stormwater system and were observed in the freshwater environment. As a result, Auckland Transport have banned the use of the foam as weed management practice. Foam was included in the long list of options but is not considered in the shortlisted for the reason above.
- The options analysis was based on the information provided by Auckland Council, available literature at the time of writing, consultations (contractors and academics), and the Ministry for Environment. A specific organic herbicide has not been specified in this options analysis. Given the current global scrutiny on glyphosate the agrochemical industry is developing more environmentally friendly options and alternatives (e.g., removing surfactants from glyphosate products). The selection of any Organic Herbicide should undergo rigorous testing to ensure potential environmental impacts are adequately reduced and assess efficacy of a given product.
- Different methods may be more suited in certain circumstances across the roading network. for example, a high-volume metropolitan road may require a different approach to quiet rural road particularly regarding traffic management and ease of application. The purpose of this options analysis is to inform the selection of a regional method for weed management in the urban setting. This analysis has not accounted for varying spatial contexts and as far as possible seeks to provide a per/km analysis across criteria.

4. Weed Management Approaches

4.1. Introduction

There are several weed management methodologies utilised internationally which have been studied for both their efficacy and impacts on the environment. The prominent methods are discussed in this section of the report in providing the long list of options summarised in Table 3. It includes 25 specific methods across five categories. An overview of the categories and the specific methods within each is presented below in terms of:

- Their status - whether they are still under development or tried, tested and widely used.
- Benefits and shortcomings - in terms of cost, resource efficiency, efficacy and impacts.

This understanding was developed through the literature from which an initial shortlist was established and refined further through engagement with the sector specialists.

Table 3: Long list of types and specific weed management methods.

Category	Method
Synthetic Herbicides	Glyphosate
	Glyphosate + surfactants
Organic Herbicides	Corn Gluten Meal
	Citric Acid and Acetic Acid
	Clove Oil
	Organic Herbicides
Thermal	Hot Water
	Steam
	Foam
	Flame
	Electrocution
	Microwaves
	Infrared Radiation
	Laser Radiation
	Freezing
	UV
Mechanical	Line Trimmer
	Sweeping
	Hand hoe
Integrated Methods	Glyphosate + Organic Herbicide
	Glyphosate + Organic Herbicide + Thermal
	Glyphosate + Thermal
	Zero Chemical, Zero Carbon
	Organic herbicide + Thermal + Mechanical
	Glyphosate + Mechanical

4.2. Synthetic Herbicides

Synthetic herbicides, such as glyphosate, are developed as systematic weed killers targeting the entire plant system, not just the plant tissue the herbicide comes in to contact with. This does however mean that it is toxic to other flora and fauna. Its efficacy has seen Glyphosate widely used in the urban and rural environments across the globe, and Glyphosate is currently used as the primary weed control for most local boards in Auckland. A crucial difference between glyphosate application in the urban versus rural environments is the ability for glyphosate to breakdown. Porous soils in the rural environment allow glyphosate to percolate through the soil as it attaches to soil colloids before bacteria breaks it down (Botta *et al.* 2009). The urban environment is highly impervious and designed to rapidly channel storm water to receiving waterways, reducing the potential for glyphosate to break down and posing a threat to aquatic life. Botta *et al.* (2009) compared glyphosate runoff in the urban versus rural watersheds, finding glyphosate concentrations 94 times in the urban catchment than the rural catchment. One of the key objectives of the standardised methodology is to consequently limit this risk by reducing the volume of glyphosate being applied to Tāmaki Makaurau’s urban spaces.

The use of glyphosate has come under global scrutiny due to the environmental impacts and some studies drawing conclusions that glyphosate is linked to human health issues, although this remains contentious. Global debate continues around glyphosate impacts on human health², leading to several countries including the Netherlands and Fiji to ban glyphosate⁴. Currently there is no strong scientific links between glyphosate herbicide application and human health with the New Zealand Environmental Protection Agency (EPA) declaring glyphosate as unlikely to be genotoxic or carcinogenic (EPA, 2016). The EPA recently produced a report from a call for information of glyphosate users which may result in further assessment of glyphosate and its impact on human health (EPA, 2022). It is worth noting that adjuvants, such as wetting agents or surfactants, that can increase the effectiveness of the product, have been shown to be toxic and can cause environmental harm. The consideration of synthetic herbicides in the short list are only those without these toxic additives.

The environmental impacts, coupled with negative public perceptions around human health impacts has seen glyphosate being banned, phased out and reduced in many countries (Winer, 2014). Globally research and development of alternative weed management strategies focusing on organic herbicides that breakdown quickly and are less toxic, and various thermal treatment options. As a result, Auckland Council is seeking to reduce glyphosate, progressing to alternatives for weed management in the urban setting.

4.2.1. Glyphosate Based Herbicides

Description

Glyphosate is widely used since it arrived on the market in 1974. Glyphosate is a systemic weed control. Glyphosate works by preventing plants from producing essential amino acids (Mesnage *et al.*, 2019).

Strengths & Weaknesses

Strengths: Long lasting, low cost, emissions, and water usage. Systemic synthetic herbicide targeting both top growth and root systems of plants. Lower labour costs as fewer applications are required annually compared to other controls.

4

	<p>Weaknesses: Negative impact on environment, falling out of favour globally with a lot of studies noting potential impacts on human and environmental health. Mana Whenua would like to see glyphosate use reduced in the urban areas.</p>
Status	<p>Widely tested and used across the globe. Glyphosate is, however, being phased out, banned (e.g. Netherlands) or heavily restricted in at least 43 countries globally as of August 2021. The New Zealand EPA concluded in 2016 that glyphosate is not genotoxic or carcinogenic to humans under HSNO act. However, these findings have been disputed. Recently the EPA placed a call for information from the users of glyphosate and as part of the next steps may undertake a reassessment of glyphosate (EPA, 2022). <i>The next steps for the EPA are to: decide whether to seek grounds for reassessment of glyphosate; engage with Māori on the topic of glyphosate; review POEA surfactants; use existing channels to reinforce the safe use of glyphosate.</i></p>

4.3. Organic Herbicides

There has been an uptake in the use of organic herbicides globally following debate around glyphosate and organic herbicides typically breakdown in the environment quickly. Organic herbicides are contact only and only the plant tissue that encounters the herbicide will be affected, therefore regular application (monthly) is often required. Most organic herbicides have less impact on the environment as they breakdown much easier than glyphosate, however, some, such as clove oil, are still toxic to flora and fauna. Depending on the organic herbicide used, these can be harmful to humans and often have unpleasant odours that can cause nausea.

4.3.1. Corn Gluten Meal

Description	<p>Corn Gluten Meal (CGM) is a by-product of corn syrup and starch. Flaming is required prior to applying CGM in a smothering effect.</p>
Strengths & Weaknesses	<p>Strengths: Environmentally friendly. Primary water and emissions would come from producing the product (though it is getting produced regardless being a by-product). Abouzienna <i>et al.</i> (2009), suggests CGM offers 70-90% weed control.</p> <p>Weaknesses: Low efficacy long term as the 10% nitrogen component was shown to enhance weed growth, acting as a fertiliser and extended the primary growing season. Expensive as large volumes are required and is a laborious and slow application process (Barker and Prostack, 2009). Flaming of the plant is required before the CGM is applied, increasing costs and risks.</p>
Status	<p>Limited research, but some of this information suggests that it is ineffective and expensive.</p>

4.3.2. Citric Acid and Acetic (vinegar) Acid

Description	Citric Acid and Acetic (vinegar) Acid are naturally occurring acids, that are readily available.
Strengths & Weaknesses	<p>Strengths: works well on some young perennial and annual species in higher concentrations, breaking down the above ground plant's tissue (Barker and Prostak, 2009). Water usage and emissions are low.</p> <p>Weaknesses: Does not control established perennials well, with regrowth occurring within a few weeks. Doesn't work effectively on all weed species (selective). Best results are achieved within two-weeks of weed emergence with decreasing return beyond the two-week window. Most studies reported concentrations more than 10% were required to achieve die off for most weed species (Abouzienna <i>et al</i>, 2009).</p>
Status	Growing research into these applications. They're selective nature means other methods will be needed to achieve the desired performance requirements.

4.3.3. Clove Oil

Description	Clove Oil is produced from the clove plant <i>Syzygium aromaticum</i> and can be fatal to many biota including humans, depending on dosage.
Strengths & Weaknesses	<p>Strengths: works well on some young perennial and annual species in higher concentrations, breaking down the above ground plant's tissue (Barker and Prostak, 2009). Water usage and emissions are low.</p> <p>Weaknesses: Control of established perennials poor, with regrowth occurring within a few weeks. Doesn't work effectively on all weed species (selective). Best results are achieved within two-weeks of weed emergence with decreasing return beyond the two-week window.</p>
Status	Growing research into these applications. The Selective nature means other methods will be needed to compliment a clove oil application to achieve the required performance.

4.3.4. Organic herbicide

Description	Plant based herbicide (fatty acids) products such as 'Organic Interceptor', 'bio-weed blast' and 'Agpro Bio-safe' a fatty acid-based product (Pine essence and coconut oil respectively) used on over 1000 km of Auckland Road corridor annually.
Strengths & Weaknesses	Strengths: Breaks down easily and has less of an impact on the environment compared to glyphosate-based herbicides. Doesn't markedly increase the emissions and water usage compared to glyphosate herbicide applications. Travlos <i>et al</i> . (2020) noted that

pelargonic acid mixed with manuka oil was found to have some systematic impact on broadleaf species.

Weaknesses: Contact only weed killer, in that only the plant tissues that comes into contact with organic herbicide products will experience die-off (i.e. doesn't impact the root systems and seed bank. Higher cost as it requires more applications annually than glyphosate herbicides.

Status

Ciriminna *et al.* (2019), noted an uptake in the use of pelargonic acid formulation as an organic herbicide as it continues to develop.

4.4. Thermal

Thermal options use various processes to cause weed tissue to expand and rupture. Currently, several thermal techniques are still experimental, whereby the inputs/investment/space have not yet been deemed feasible for broad commercial application, particularly in the urban environment. Thermal methods used around Auckland currently require large equipment, more labour, high energy, and costly traffic management inputs. A key factor raised by a current contractor was the lack of feasibility for thermal methods such as steam on arterial routes and busy roads because of the traffic management requirements. As thermal applications are not systematic weed killers, monthly treatment is usually required. The list here includes innovative methods many of which will be pioneered through the agricultural use rather than targeting pavement weeds.

4.4.1. Hot Water

Description

A diesel-powered boiler mounted to a truck is used to superheat water which when discharged at the end of a wand. The heat transfer to the weed results in plant tissue bursting (Moretto and Di Domenico, 2017).

Strengths & Weaknesses

Strengths: Minimal downstream impacts on the environment.

Weaknesses: Huge water consumption at 5000 L per km annually. Emissions are high at over 200 times that of glyphosate. Established perennials are require large doses to achieve desired results. Traffic management is required as part of foam application, which increases the cost significantly, which rules out foam for arterial roads.

Status

Currently applied in northeastern local boards (greater North Shore region). Improvements into the efficiency of hot water are required (Ascard *et al.*, 2007).

4.4.2. Steam

Description

A diesel-powered boiler mounted to a truck is used to superheat water which when discharged at the end of a wand is converted to steam at

atmospheric pressure. The heat transfer to the weed results in plant tissue bursting (Moretto and Di Domenico, 2017).

Strengths & Weaknesses

Strengths: Uses less water than a hot-water application. No downstream environmental impacts. Has higher heat “transfer coefficient” in comparison to hot-water systems (Rask and Kristofferson, 2007).

Weaknesses: Still noted as inefficient and has high emissions outputs (Cave *et al*, 2021). High cost, especially the initial investment costs. Traffic management is required on busy roads as part of the steam application, which increases the cost significantly.

Status

Applied globally but inefficiencies have meant steam is not often used as a standalone weed management option (Cave *et al*, 2021).

4.4.3. Foam

Description

Innovative system developed in New Zealand (Waipuna). The foam works by insulating (trapping the heat) the weed for longer than standard hot water systems (Rask and Kristofferson, 2007).

Strengths & Weaknesses

Strength: More effective at controlling weeds (particularly young annuals and perennials) than other thermal options (Rask and Kristofferson, 2007) while using less water (Auckland Council, 2020).

Weaknesses: Repeated application is required on established perennial weeds. Only targets the above ground section of the weed (minimal systematic penetration). Foam is visible to the public, potentially creating temporary safety hazard. Emissions are high. Traffic management is required as part of foam application, which increases the cost significantly, which rules out foam for arterial roads. Concerns over the environmental effect of soaps used to create the foam.

Status

Innovative technique developed in New Zealand that builds on previous thermal treatment options. Auckland Transport do not consider foam appropriate due to foam remaining present and entering waterways where it can persist for some time.

4.4.4. Flame

Description

Flame weeding is where LPG or propane is used to create a flame which ruptures the tissues of the weed causing it to die (Ascard *et al*, 2007).

Strengths & Weaknesses

Strengths: No water usage.

Weaknesses: Works best on young annual within three weeks of emergence (small timeframe for application and various weeds

emerge at different points of the season). Requires multiple applications with weed re-emerging within 30 days (Nazer *et al*, 1999; Moretto and Di Domenico, 2017) and high emissions (Winer, 2019). Fire risk in dry environments.

Status Flame weeding has been developing as a weed control method since the 1940's (Ascard *et al*, 2007), but is noted as having a low efficacy and resulting in high emissions. Concept development of flame weeding apparatus appears to be focused on agricultural use e.g., Spagnolo *et al*. (2019).

4.4.5. Electrocutation

Description Weeds are electrocuted via a high voltage pulse passing between two electrodes or an electrode contacting the weed at a minimum of 20 kV (Rask and Kristofferson, 2007).

Strengths & Weaknesses Strengths: Electrocutation has been shown to cause some systematic damage to the root/rhizome system of weed species. (Rask and Kristofferson, 2007). No water usage. No downstream environmental damage.

Weaknesses: High energy consumption. Still developing technology, not ready for roll out in the urban environment.

Status Still in the development stages (Pers comms. Associate Professor Kerry Harrington). Only commercially applied in the agricultural industry (Ascard *et al*, 2007).

4.4.6. Microwaves

Description The same process as a microwave in your kitchen. The microwaves cause water molecules inside the weed's tissues to oscillate and heat up, 'cooking' the weed from the inside out (Ascard *et al*, 2007).

Strengths & Weaknesses Strengths: No water usage, no downstream environmental effects.
Weaknesses: Different plants require different wavelengths to attain optimum results. High energy consumption required plus an estimated 4000 L of diesel per hectare is required, and the concept is still experimental (Rask and Kristofferson, 2007).

Status The concept of microwave radiation is well understood, however, creating a portable device that consumes little energy, and targets all weed species is not yet available. Different weeds require different wavelengths to achieve die-off. This would require multiple passes and increasing the cost.

4.4.7. Infrared Radiation

Description	Ceramic panels are heated to operating temperatures of 900 degrees Celsius, causing the plant tissue to heat, expand and rupture (Ascard <i>et al</i> , 2007).
Strengths & Weaknesses	Strengths: No water usage, no downstream environmental effects. Weakness: Equipment is sensitive, with the large panels subject to damage over coarse urban materials such as pavement, asphalt. Large initial investment would be required. Different weeds require different wavelengths to achieve optimal die-off. (Rask and Kristofferson, 2007). High emissions.
Status	Primarily used in agricultural settings over large fields. Noted as a potential new technique for managing weeds in the urban space (Abouziena and Haggag. 2016). Not yet widely adopted.

4.4.8. Laser Radiation

Description	High intensity lasers are point at the weed, causing the plant tissue to heat preventing or stunting growth.
Strengths & Weaknesses	Strengths: No water usage, no downstream environmental effects. Weaknesses: large energy inputs required to achieve substantial die off. Different weed species require different wavelengths and exposure times to work (Mathiassen <i>et al</i> , 2006).
Status	Noted as new technique for managing weeds (Abouziena and Haggag. 2016). Not yet widely adopted.

4.4.9. Freezing

Description	Liquid nitrogen or dry ice is used to freeze the above ground section of the weed.
Strengths & Weaknesses	Strengths: limited downstream environmental effects. Weaknesses: Liquid nitrogen or dry ice is required to undertake this method which is expensive and requires a lot of energy (3-6 times that of flaming methods (Ascard <i>et al</i> , 2007)). Only treats the above ground plant tissue. Some weed species are also tolerant to freezing and will continue to grow. Low efficacy and high cost.
Status	Not widely used globally (Winer, 2019)

4.4.10.UV – Radiation

Description	Weeds are subject to UV irradiation, causing the plant tissue to heat, expand and rupture (Fogelberg, 2001).
Strengths & Weaknesses	Strengths: No water usage, no downstream environmental effects. Weaknesses: Largely experimental and requires a lot of energy (high emissions) (Ascard <i>et al</i> , 2007). Large initial investment cost compared to effectiveness of the treatment (low ROI).
Status	Noted as new technique for managing weeds. Not yet widely adopted.

4.5. Mechanical

Mechanical methods remove the above ground sections of weeds by cutting, sweeping, and pulling the weeds out. As a result, multiple applications are required annually. One of the major drawbacks for mechanical methods is the labour intensity, requiring a lot of input to cover large areas.

4.5.1. Line Trimmer

Description	The use of a handheld line trimmer to cut weeds off at ground level.
Strengths & Weaknesses	Strengths: Low emissions, no water usage. Weaknesses: Only targets the above ground section of the weed with the seed bank being able to regenerate quickly. High labour costs and creates risks around potential damage to the pavement surface as well (Rask and Kristofferson, 2007). Nylon/plastic is lost to the environment. Can be noisy.
Status	Works for small scale weeding. Not viable as a standalone method across 5,055 km of roading. Battery driven units lack endurance.

4.5.2. Sweeper

Description	Mobile street sweeper utilised to sweep weeds off the road corridor.
Strengths & Weaknesses	Strengths: no water usage, can remove some of the dirt within pavement cracks that promotes weed growth. No downstream environmental impacts. Weaknesses: Manoeuvrability issues and therefore cannot operate as a standalone weed management approach. Large initial investment costs. Large equipment so limited access and issues with roadside parking

Status Utilised to clear leaves/dirt out of guttering in Auckland already. Globally there are no examples of sweepers used as a standalone weed management tool, often paired with other methods.

4.5.3. Hand hoeing

Description Hand pulling of weeds.

Strengths & Weaknesses Strengths: Low emissions, no water usage, no environmental impact.
Weaknesses: High cost, difficult to get sufficient labour. Strenuous on labour.

Status Not feasible over large areas.

4.6. Integrated Approaches

Integrated approaches involve using a combination of methods to achieve weed management in the urban space. By using a combination of weed control methods, some of the inefficiencies and drawbacks of certain methods can be balanced out with others.

4.6.1. Glyphosate and Organic herbicide

Description Glyphosate application is integrated with Organic herbicide, where Glyphosate is applied during the period of the year when weeds are most active (Summer and Autumn) and organic herbicide is used for the other times of the year.

Strengths & Weaknesses Strengths: This approach will see a reduction in the volume of glyphosate applied in Auckland's urban environment annually, reducing the impact on the receiving environments. Emissions and water use also remain low in comparison to thermal methods.
Weaknesses: The cost is marginally higher than just using glyphosate alone (PWC, 2015), as additional organic herbicide applications are required in comparison to just using glyphosate. Glyphosate is still being applied with the associated negative environmental impacts and perceptions.

Status Both methods used as standalone approaches by several local boards and as a combination by two local boards (Orākei and Maungakiekie-Tāmaki). On-going development of organic herbicide products will continue as countries move to reduce glyphosate use.

4.6.2. Glyphosate, organic herbicide and thermal.

Description	Glyphosate application is integrated with Organic Herbicide and thermal methods (e.g. steam), where Glyphosate is applied during the period of the year when weeds are most active (Summer and Autumn) and organic herbicide and thermal methods is used for the other times of the year. Thermal methods can be used in areas where herbicide is not suitable. The specific thermal methods have not been defined as this will allow scope for contractors to assess relative feasibility of individual thermal methods as well as access to equipment before deciding the best course for action. The specific thermal methods have not been defined as this will be based on discussion with contractors to assess the feasibility of individual thermal methods before deciding the best course for action.
Strengths & Weaknesses	<p>Strengths: By incorporating glyphosate in with organic herbicide and other thermal options across Auckland, there will be an overall reduction glyphosate use.</p> <p>Weaknesses: Glyphosate is still being applied with the associated negative environmental impacts. The cost compared to glyphosate alone is higher (PWC, 2015).</p>
Status	The methods mentioned are used as standalone or integrated approaches by several local boards currently. On-going development of organic herbicide products will continue as countries move to reduce glyphosate use.

4.6.3. Glyphosate and Mechanical

Description	Glyphosate application is integrated with mechanical methods, where Glyphosate is applied during the period of the year when weeds are most active (Summer and Autumn) and mechanical methods are used to maintain the weed control.
Strengths & Weaknesses	<p>Strengths: This approach will see a reduction in the volume of glyphosate applied in Auckland's urban environment annually reducing the impact on the receiving environments. Emissions and water use will also be reduced in comparison to current methodologies.</p> <p>Weaknesses: Glyphosate is still being applied with the associated negative environmental impacts. Costs per km will increase from the additional labour of weed ripping which will likely be required more frequently that with other methods. Weed ripping can cause damage to the pavement depending on the head used (Winer, 2014). There are also public property and safety risks around mechanical methods (e.g., chipped windscreens).</p>
Status	Both approaches are used across the globe to control weeds.

4.6.4. Glyphosate and thermal

Description	Glyphosate application is integrated with thermal methods (e.g. steam), where Glyphosate is applied in the more inaccessible areas or busy roads that would require expensive traffic management and thermal methods are utilised as much as feasible. The specific thermal methods have not been defined as this will be based on discussion with contractors to assess the feasibility of individual thermal methods before deciding the best course for action.
Strengths & Weaknesses	<p>Strengths: By increasing the utilisation of thermal methods, glyphosate usage is reduced.</p> <p>Weaknesses: Glyphosate is still being applied with the associated negative environmental impacts. The cost compared to glyphosate alone is higher (PWC, 2015) and the emission and water usage will increase with the uptake in thermal methods. Emissions are high with thermal methods. Traffic management is required as part of thermal application, which increases the cost significantly.</p>
Status	The methods mentioned are used as standalone or integrated approaches by several local boards currently.

4.6.5. Zero Chemical, (Mechanical and thermal only)

Description	No herbicide is applied. Mechanical and thermal methods are applied monthly. Where thermal methods are not feasible, mechanical methods such as weed ripping are used (e.g. arterial routes). The thermal methods would have to be zero carbon such as electric trucks, and all water used would have to be non-potable as more non-potable sources come online across Auckland.
Strengths & Weaknesses	<p>Strengths: The risk of herbicide resistance is not an issue. No direct carbon emissions with battery powered options and innovative technologies plus, non-potable water sources. No downstream environmental impacts. Aligns with Auckland Council strategic plan to reach net zero.</p> <p>Weaknesses: Huge upfront investment cost in gathering the electric. Thermal treatment has large energy requirements, which will be difficult to meet using electric trucks. Due to the monthly treatment required, roughly 35- 45 trucks would have to be in operation daily as a truck and two-man crew travel roughly 5 km per day. At roughly \$250,000 each, there is a \$11,250,000 upfront cost for the trucks alone (excluding heating units).</p>
Status	Novel approach aiming to tackle emissions, water, and glyphosate use.

4.6.6. Organic herbicide, thermal and mechanical

Description	Mechanical, organic herbicides, and thermal methods are applied monthly. Organic herbicide is balanced with thermal methods, with mechanical methods used to cover inaccessible areas/spaces where herbicides cannot be applied. Where thermal methods are not feasible, organic or mechanical methods such as weed ripping are used (e.g. arterial routes).
Strengths & Weaknesses	<p>Strengths: No glyphosate, no downstream environmental impacts.</p> <p>Weaknesses: Large initial investment costs to upgrade thermal equipment available for contractors. Monthly applications required, which increases costs overall. High labour costs. Thermal will require more water and create more emissions in comparison herbicide only approaches.</p>
Status	All methods are used across the globe to control weeds.

4.7. Summary

The short-list of options presented below emerged as potential options for managing weeds in the urban road corridors for Tāmaki Makaurau, based an initial analysis that considered:

- The outcomes of previous investigation and resolution that formed the basis for this work including and outlined in the introduction - reduce the use of synthetic herbicides, potable water use, reduce emissions.
- State of development – a spectrum from experimental, to tested, certified, and widely applied over a long period). Several of the options in this long list of options, particularly innovative thermal and ‘dry’ thermal options, are still emerging. The technological development of these options has not advanced to a point where they are technically and/ or financially feasible based on which they were not included in the shortlist.
- Practical considerations such as the need avoid weeds becoming resistant to single methods.
- Efficacy in achieving the specification.
- Capital and operating costs.
- These options are also based on the equipment available to contractors and provides some flexibility i.e., not specifying the mechanical method (could be sweeper or line trimmer etc.) and limited thermal technologies to hot water and/or steam.
- Foam trials were not positively received by Auckland Transport due to the presence of foam in the receiving environments after application and this method is therefore not considered further.

The short-listed options considered in the options analysis (Section 5) are:

- Glyphosate
- Organic Herbicide

- Mechanical
- Thermal (Hot water or Steam)
- Combo 1: Glyphosate and organic herbicide
- Combo 2: Glyphosate, organic herbicide and thermal
- Combo 3: Glyphosate and mechanical
- Combo 4: Glyphosate and thermal
- Combo 5: Zero Chemical (mechanical and thermal)
- Combo 6: Organic herbicide, thermal and mechanical

5. Options Analysis Methods

The short-listed options were analysed against the following factors, which were confirmed with Auckland Council:

- Health and Safety (Operator and Public, two separate factors)
- CO_{2e} emissions
- Water Usage
- Cost
- Potential Risk to the Freshwater Environment

Water use, CO_{2e} emissions, potential risk to freshwater and cost were assessed on a per kilometre of roading basis, while health and safety factors were assessed qualitatively. Each option was ranked against each other. The rankings were combined with the lowest score being the weed management option that best meets the objective of a specific criteria. All the factors used in the options analysis are based on weed management in the roading corridor only. The methods and assumptions for each factor assessed are provided in the sections below.

The number of applications for each weed management methodology was determined based on contractor feedback established through the current approaches across the Auckland district. Thermal methods tend to require monthly applications while glyphosate is required to be applied four to five times annually.

All the methods and data assessed within this options analysis is used on application per linear meter for comparison purposes. Therefore, town centres which are priced, per square meter of application and require more annual applications, are not included in this analysis. The authors also recognise that not all methods are suitable for all locations. Given the regional nature of this assessment location specific aspects are outside of the scope of the evaluation process.

There are no weighting criteria applied to any of the factors involved in the ranking of options. No supporting evidence was found to guide any weighting or criteria.

5.1. Operator and Public Health and Safety

Operator and public health and Safety were assigned based on qualitative feedback from contractors currently undertaking weed management practices and industry experience. The feedback was provided in a standard risk matrix that combines the severity of consequence with the likelihood of occurrence in generating a risk score. All contractors provided a rating between zero and four for the likelihood score and severity of consequence score to generate the overall risk score (Appendix 3). Zero would mean no likelihood of occurring and no consequence and four represents a definite likelihood and high consequence (major long term health implications). The highest score could therefore be 16. All the scores provided by the individual contractor were then averaged to provide the overall health and safety scores.

5.2. Emissions Calculations

The Emissions Calculations were based on the Ministry for Environment (MfE) (2022) measuring emissions guide. The majority of the data provided within the MfE guidance is on a per kilometre basis so can be

directly translated to a per kilometre CO_{2e} for weed management. The MfE guide also included diesel burners which are used to heat the water for thermal methods. The diesel usage per kilometre was estimated at 0.5 L per km.

The following are assumptions for the carbon calculations.

- One kilometre of road takes one hour for each methodology. It is understood to be between 1.1 and 1.8 km per hour, however, 1 km per hour was used for simplicity.
- Default light commercial vehicle emissions factors were used and all vehicles were assumed to be in the newer than 2015 category.
- Assumed that all trucks were in the 5000-7000 kg range.
- Assumed that any vegetation/weed waste is not removed from site.
- For mechanical – line trimmers are not included in the MfE guide, however, <60 cc motorcycles are and standard line trimmers being 49 cc the motorcycle value was used.

5.3. Water Usage

Water usage was determined based on feedback provided by contractors and estimates provided by Auckland Transport's 2020 regional review. The data provided was based on annual usage per kilometre of roading network. The annual usage was divided by number of applications required annually to give a per application water usage. The per application usage was then multiplied by the specified number of applications ratios pertaining to each combination method.

5.4. Cost per Kilometre

Several contractors were invited to tender for managing weeds in both the urban corridor and town centres by Auckland Council. The tender process was managed by Auckland Council whereby the specifications were circulated to the contractors with a request for quotations (RFQ). The RFQ included multiple treatment zones such as town centre. Town centres are not included in this analysis.

The cost per kilometre for each option was determined by averaging the price per kilometre for different methods across all contractors that provided pricing against each weed management method. Importantly, only one of the contractors provided a price for mechanical weed management due to this being an impractical (time and labour resource needs) and therefore also economically unviable, option.

5.5. Potential Risk to the Freshwater Environment

There is significant literature focussed on the specific impacts of glyphosate on the freshwater environment including the impact at a species level and the environmental concentrations across catchments. Glyphosate itself can break down rapidly in soils, with the half-life estimated at 1.7-142 days depending on a range of factors including the specific glyphosate-based product used (Annett, Habibi, & Hontela, 2014). The metabolite (product of the breakdown of glyphosate) of glyphosate, Aminomethylphosphonic Acid (APMA) is more persistent and mobile in soils (Annett, Habibi, & Hontela, 2014) and arguably more toxic (Bonansea, Filippi, Wunderlin, Mariona, & Ame, 2017). However, there are few studies that have examined the toxicity of AMPA on freshwater systems (Annett, Habibi, & Hontela, 2014).

Botta *et al.* (2009) compared glyphosate runoff in the urban versus rural watersheds, finding glyphosate concentrations 94 times in the urban watershed in one catchment in France. In comparison, Meadlie *et al.*, (2020) compared glyphosate and AMPA levels across multiple catchments of varying land use in the USA. More developed (i.e., urban catchments) had higher levels of glyphosate in the catchment compared to rural catchments and vice versa. The likely cause is linked to the conveyance time in the urban watershed compared to the rural watershed where glyphosate has more time to breakdown and produce AMPA.

Several papers have commented on the toxicity of glyphosate on macro algae and aquatic plants (Annett, et al., 2014; Alcivar et al., 2021). This is not unexpected given that glyphosate was designed to target and enzyme essential to plant life (Annett, Habibi, & Hontela, 2014). Amphibians are also noted particularly sensitive to glyphosate and AMPA (Annet *et al.*, 2014). Fish species and invertebrates have much higher tolerances for glyphosate, particularly at environmental representative concentrations (Alcivar et al., 2021).

5.5.1. Environmentally Representative Concentrations and Measuring Toxicity

Establishing environmentally representative concentrations of glyphosate in freshwater systems is important to assess the scale of the impact. The Hazard Quotient developed by Annett *et al.* (2014) is based on the Toxicity Reference Value after Giesy et al. (2000). Lewis (2017) notes that glyphosate concentrations in an Auckland catchment were contained within the stormwater sediments with the receiving estuarine environment not having high concentrations of Glyphosate.

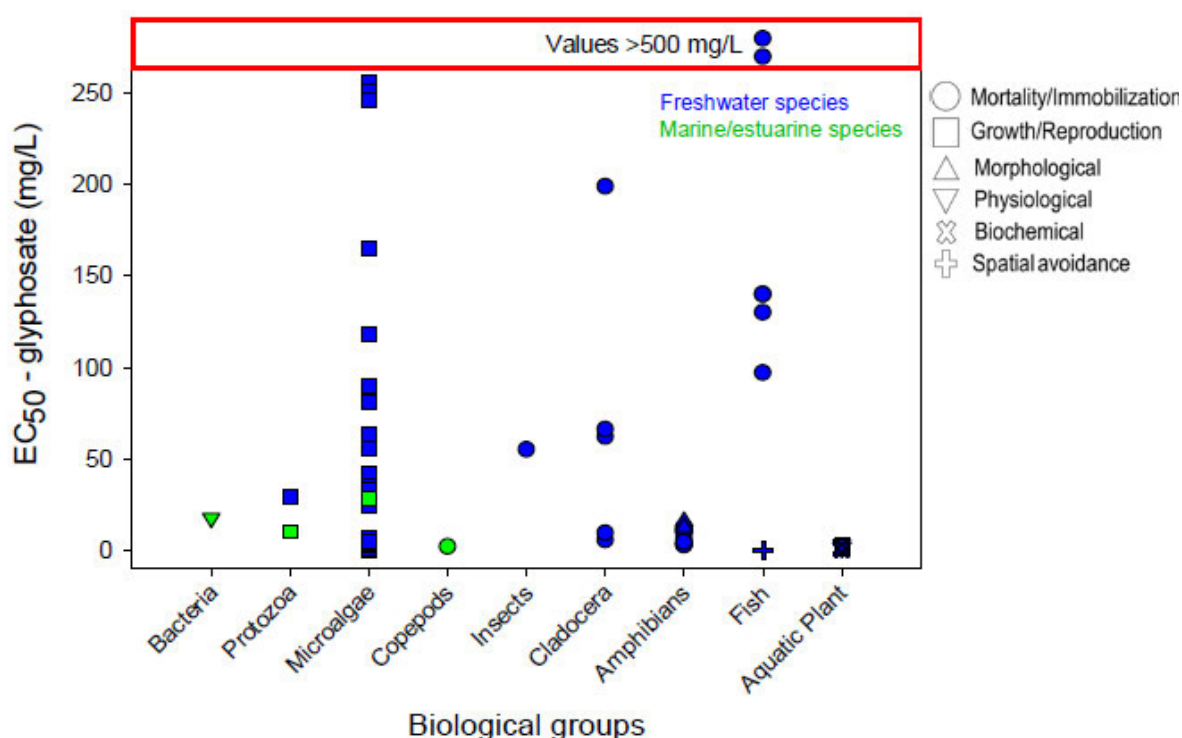


Figure 3: Toxicity of glyphosate for different biological groups. Source: Alcivar et al 2021.

5.5.2. New Zealand Specific Research

At a species level in New Zealand, some research has been conducted. However, the animal testing laws in New Zealand prevent widespread testing on native species (Weir *et al.*, 2016). Kelly *et al.* (2010) provides the most substantial study on aquatic life, examining the synergistic effects of glyphosate on the *galaxias anomalus* or the Central Otago roundhead galaxias. The introduction of glyphosate into the tanks increased the infections rates of the parasite *trematoda* in *galaxias anomalus*.

The test results from environmentally representative glyphosate levels in freshwater systems showed that survival of the fish with glyphosate alone was not affected Kelly *et al.* (2010). While, when the parasite *trematoda* (which is shed by aquatic snails) was introduced as well as glyphosate, mortality, and malformation of the *galaxias anomalus* spine were statistically higher. Snails that were exposed to environmentally representative concentrations (3.6 mg/L) of glyphosate increased the production of the trematode worms. This could be due to two reasons. Either the snails respond to the stressors of glyphosate that raises cortisol levels so the parasitic worm increases production as it thinks the host is about to die or due to the fact the glyphosate increases the production in freshwater systems of periphyton which produces more food for the snails to eat. This process did not occur at the low concentration level of 0.36 mg/L of glyphosate. There were no links discussed between glyphosate and it's metabolite AMPA Kelly *et al.* (2010).

In summary, Glyphosate has an impact on freshwater systems, but many of the impacts are indirect, and complex to establish causality and magnitude of the effect. Consequently, there is no holistic method to quantify the impact.

There is a substantial gap in the literature around the impacts of organic herbicides. However, it is acknowledged that there will also be some impact on freshwater systems based on research from Pesce *et al.* 2011 and Malaj *et al.* 2014. An organic herbicide product known as 'bio weed blast' used by multiple Councils in New Zealand notes on the label under environmental care, "*Harmful to terrestrial vertebrates. Slightly harmful to aquatic life. Avoid release to the aquatic environment, do not spray into or onto water.*" Thereby alluding to the potential risks associated with this particular organic herbicide.

5.5.3. Assessment Methodology

Given the lack of definitive understanding regarding the impact of herbicides on freshwater ecosystems, the alternative approach adopted here, has been to assess the potential risk on herbicides on freshwater systems via the total amount of herbicide required by kilometre of roading corridor. This was calculated based on the dilution ratios provided by manufacturers (e.g., Apparent Glyphosate Green 360⁵) which is 1:100 ratio. Based on the total water usage, the volume of herbicide applied per kilometre can be determined. It was assumed for simplicity that organic herbicides employed the same mixing ratios, though it is noted that some organic herbicides require stronger concentrations of the listed active ingredient (e.g., 7:100 for bio weed blast). The larger the water usage, the more herbicide applied. This is not a direct comparison between glyphosate and organic herbicides and the potential risk to the freshwater environment rather the total volume of herbicide applied per kilometre. The more herbicide applied per kilometre, the greater the potential for herbicide to enter waterways. Thermal and mechanical methods were determined to not impact the freshwater systems as there is either no runoff into the freshwater environment or just water.

⁵ https://apparentag.com.au/documents/brochures/080-App-Glyphosate-Green-360_Booklet.pdf

5.6. Application Ratios

The application ratios refer to the number of applications of the weed management methodologies assessed in this options analysis. The ratios include the anticipated number of applications of each individual methodology required in the combination methods. Application ratios were determined by the current applications ratios being applied by contractors. The current application ratios are determined to meet the weed management specifications and therefore are appropriate. Combination ratios were decided based on the management methodologies within the combination. i.e., glyphosate requires fewer annual treatments compared to thermal methods. The various application ratios are displayed in Table 4.

Table 4: Applications ratios for each weed management methodology.

Weed Management Option	Application Ratio
Glyphosate	5
Organic herbicide	7
Mechanical	12
Thermal (hot water or Steam)	12
Combo 1: Glyphosate and organic herbicide	3:4
Combo 2: Glyphosate, organic herbicide and thermal	3:3:3
Combo 3: Glyphosate and mechanical	3:6
Combo 4: Glyphosate and thermal	3:6
Combo 5: Zero chemical (mechanical and thermal only)	6:6
Combo 6: Organic herbicide, thermal and mechanical	4:3:3

6. Results and Discussion

6.1. Operator Health and Safety

The qualitative ranking provided by contractors indicates there is little divergence between the weed management options for the operators administering the weed treatment options (Table 5). Organic herbicide had the lowest perceived health and safety risk across all contractors, while all other methods produced the same average health and safety risk. Organic herbicides are known to have pungent odours and may cause nausea but the perceived health and safety risk to the operator applying the herbicide is low. It is important to note that a score of 16 would be highly likely to occur and highly likely to result in catastrophic injury of death. In view of this, all methods are considered to have very low/negligible impact 1 or 2 out of a possible 16.

Table 5: Averaged operator health and safety scores against the different weed management options.

Weed Management Option	Ranking	Operator H&S
Glyphosate	2	2.50
Organic herbicide	1	2.17
Mechanical	2	2.50
Thermal (hot water or Steam)	2	2.50
Combo 1: Glyphosate and organic herbicide	2	2.50
Combo 2: Glyphosate, organic herbicide and thermal	2	2.50
Combo 3: Glyphosate and mechanical	2	2.50
Combo 4: Glyphosate and thermal	2	2.50
Combo 5: Zero chemical (mechanical and thermal only)	2	2.50
Combo 6: Organic herbicide, thermal and mechanical	2	2.50

6.2. Public Health and Safety

Greater variance was observed across the public health and safety risk across the weed management methods (Table 6). Thermal methods had the lowest risk (1.83/16) to the public while mechanical methods had a higher risk (3.67/16). This is likely because of the potential for debris projectiles from the mechanical operations, while traffic management is often required for thermal methods, excluding the public from the hazard. Personal communications⁶ with one of the contractors using mechanical methods noted that an average of five windscreens a month were smashed from mechanical methods.

While the methodology for assessing risk using the industry standard health and safety risk matrices (likelihood of occurrence versus consequence) is well accepted, the scoring structure was not sensitive enough to highlight the differences between the different methods. Additional higher resolution data may have provided a different outcome and greater variance across the weed management methods.

⁶ The name of the contractor has been left out of this report for privacy reasons.

What the survey results did indicate is that while the variations in risk between methods haven't been exposed in the scoring, the overarching message from contractors via the results, and confirmed via direct interviews with two of the contractors, is that the none of the methods are considered to result in very high risk. Some of the health and safety considerations for the various weed management application methods are listed below.

- Mechanical weed management methods are likely to have a comparatively higher health and safety impact on the public (flying debris) than demonstrated in the results.
- Organic herbicides are also known to have 'offensive' odours that can impact the contractor and the public. This is unlikely to impact the health and safety scoring even with higher resolution sampling as odour is generally considered a nuisance impact, instead of a health and safety impact.
- Glyphosate based herbicides also have an odour, however, it is less offensive in comparison to organic herbicides.

Table 6: Averaged public health and safety scores against the different weed management options.

Weed Management Option	Ranking	Public H&S
Glyphosate	2	2.33
Organic herbicide	4	2.83
Mechanical	7	3.67
Thermal (hot water or Steam)	1	1.83
Combo 1: Glyphosate and organic herbicide	4	2.83
Combo 2: Glyphosate, organic herbicide and thermal	4	2.83
Combo 3: Glyphosate and mechanical	7	3.67
Combo 4: Glyphosate and thermal	2	2.33
Combo 5: Zero chemical (mechanical and thermal only)	7	3.67
Combo 6: Organic herbicide, thermal and mechanical	7	3.67

6.3. CO_{2e} emissions

Thermal alone produced the highest emissions which is expected. Glyphosate, mechanical and organic herbicides all produce similar levels of estimated CO_{2e} emissions, with organic herbicide being higher than glyphosate as additional applications are required. The combination methods range significantly depending on the thermal component or lack of in the combination method (Table 7).

Table 7: Estimated CO_{2e} emissions against the different weed management options.

Weed Management Option	Ranking	Emissions kgCO_{2e}/km/yr
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Glyphosate	3	0.97
Organic herbicide	4	1.36
Mechanical	1	0.69
Thermal (hot water or Steam)	10	19.22
Combo 1: Glyphosate and organic herbicide	4	1.36
Combo 2: Glyphosate, organic herbicide and thermal	6	5.39
Combo 3: Glyphosate and mechanical	2	0.93
Combo 4: Glyphosate and thermal	9	10.19
Combo 5: Zero chemical (mechanical and thermal only)	8	7.48
Combo 6: Organic herbicide, thermal and mechanical	7	5.45

6.4. Water usage

Thermal methods require the largest volume of water, which is expected, while mechanical methods require no water usage. Organic herbicide required more water than glyphosate due to the higher number of applications and greater volume of herbicide required to be applied to the weeds as the organic herbicides are contact only, and not systemic like glyphosate (Table 8).

Table 8: Estimate water usage per kilometre against the different weed management options.

Weed Management Option	Ranking	Water L/km/yr
Glyphosate	3	180
Organic herbicide	5	1350
Mechanical	1	0
Thermal (hot water or Steam)	10	6545
Combo 1: Glyphosate and organic herbicide	4	915
Combo 2: Glyphosate, organic herbicide and thermal	6	2323
Combo 3: Glyphosate and mechanical	2	108
Combo 4: Glyphosate and thermal	9	3381
Combo 5: Zero chemical (mechanical and thermal only)	8	3273
Combo 6: Organic herbicide, thermal and mechanical	7	2760

6.5. Cost

The costs per kilometre are displayed in Table 9 with mechanical methods the most expensive at [REDACTED] per kilometre which is not unexpected due to the laborious nature of this approach. Only one of the six contractors asked to tender provided a price for mechanical methods. The labour-intensive nature of mechanical methods would result in high costs even if the other contractors provided pricing for mechanical methods. It is probable that only one contractor provide pricing against mechanical methods due to the efficacy of mechanical methods. Glyphosate was the cheapest option per kilometre at [REDACTED], likely due to the speed of application, low operating costs and low number of annual applications. The price comparison between mechanical versus glyphosate is more than 10 times the cost per kilometre of roading corridor.

Table 9: Estimate cost per kilometre against the different weed management options.

Weed Management Option	Ranking	Cost per km/yr
Glyphosate	1	\$
Organic herbicide	3	\$
Mechanical	10	\$
Thermal (hot water or Steam)	8	\$
Combo 1: Glyphosate and organic herbicide	2	\$
Combo 2: Glyphosate, organic herbicide and thermal	4	\$
Combo 3: Glyphosate and mechanical	7	\$
Combo 4: Glyphosate and thermal	5	\$
Combo 5: Zero chemical (mechanical and thermal only)	9	\$
Combo 6: Organic herbicide, thermal and mechanical	6	\$

6.6. Risk to Freshwater Environment

All weed management methodologies that employ herbicides as stand-alone treatments or in the combinations were scored higher for reasons discussed in section 5.5 of this report. It is assumed that the risk to freshwater is greater the larger the volumes of herbicide applied to the roading corridor, though it is acknowledged that this may not be the case. Weed management methodologies that do not include herbicides or chemicals do not have impacts on freshwater and have low corresponding scores (Table 10). Further research is required to understand the nature of and quantify the magnitude of the impact of different herbicides on the freshwater environment.

Table 10: Impact on freshwater against the different weed management options.

Weed Management Option	Ranking	L of herbicide/km/yr
Glyphosate	6	1.8
Organic herbicide	10	13.5
Mechanical	1	0
Thermal (hot water or Steam)	1	0
Combo 1: Glyphosate and organic herbicide	9	8.79
Combo 2: Glyphosate, organic herbicide and thermal	7	6.87
Combo 3: Glyphosate and mechanical	4	1.08
Combo 4: Glyphosate and thermal	4	1.08
Combo 5: Zero chemical (mechanical and thermal only)	1	0
Combo 6: Organic herbicide, thermal and mechanical	8	7.71

6.7. Overall Scoring

Glyphosate as a stand-alone approach had the lowest combined or best score where all the respective rankings (Table 12) against each factor are combined (Table 11). This would be expected given that glyphosate is the cheapest, does not require large volumes of water and has comparatively lower emissions per kilometre of road corridor treated. The combination of organic herbicide, thermal and

mechanical produced the highest overall or worst ranking as there are high emissions, water usage and cost associated with these techniques. Any methodology that incorporated thermal methods scored in the bottom 50% of the management options. Again, this is due to the high emissions, cost and water usage associated with thermal weed management techniques.

Table 11: Combined score based on the ranking across all the factors assessed in the options analysis. No weighting has been applied to any of the factors assessed (each factor is weighted equally).

Weed Management Option	Combined Score	Overall Ranking
Glyphosate	18	1
Mechanical tools	23	2
Combo 3: Glyphosate and Mechanical	24	3
Combo 1: Glyphosate + Organic Herbicide	25	4
Organic herbicide	28	5
Combo 2: Glyphosate, organic herbicide and thermal	29	6
Combo 4: Glyphosate and thermal	31	7
Thermal (Hot water or Steam)	33	8
Combo 5: Zero Chemical (Mechanical and thermal only)	35	9
Combo 6: Organic herbicide, thermal and mechanical	37	10

6.8. Results Discussion

This analysis was conducted independently based on information supplied by, contractors, academics, Auckland Council, The Ministry for the Environment and Auckland Transport with a wide body of literature also examined.

Glyphosate as a standalone weed management method ranked the best based on the factors assessed in this options analysis (Table 11). A funding model based on glyphosate alone may result in an increase in the total volume of glyphosate sprayed in Auckland annually, with the North Shore Local boards all currently using thermal methods. Glyphosate as a standalone option does not meet one of Auckland Council’s primary objectives to reduce glyphosate usage across Auckland. In addition, a solitary herbicide management technique increases the potential for resistance in weed species.

Thermal methods including combination approaches that employ thermal methods, all scored in the bottom 50% of the rankings (Table 11). This is because of the high-water usage, cost and carbon emissions associated with the thermal methods (Table 7, Table 8, Table 9).

Mechanical methods as a standalone approach produced the second-best overall score. This is because there is no water required, low emissions and no herbicide is used. This option therefore meets several of Auckland Council’s primary objectives listed in Section 1.3. Mechanical methods are however the most expensive method at § 7(2)(b)(i) Prejudice to per kilometre (§ 7(2)(b)(ii) Prejudice to commercial for the entire roading network). It will also require several methods such as hand pulling, sweeper trucks to accompany the primary method of a line trimmer to suit different spatial settings. The risk to public health and safety was also the highest for mechanical methods (one contractor noted on average five windscreens/month being damaged). The efficacy of mechanical methods is low due to the labour-intensive approach required and it may be difficult to meet the specifications of any weed management contract. The evidence is that only one of the six contractors requested to provide pricing provided a price against mechanical methods.

The combination of mechanical and glyphosate produced the third best score. Again, this is because there is little water required and low emissions are generated but it does employ glyphosate as a weed

management and therefore there is a potential risk to the freshwater environment. Mechanical combined with glyphosate will reduce glyphosate usage across Auckland with the largest local board areas in the South and the West water usage, CO_{2e} emissions. However, there will be a substantial increase in cost (estimated at [REDACTED] for the entire roading network).

The combination method of organic herbicide and glyphosate produced the fourth-best score. The glyphosate and organic herbicide option will reduce glyphosate usage across Auckland with the largest local board areas in the South and the West water usage, CO_{2e} emissions without substantial cost increases. Thereby, meeting several of Auckland Council's primary objectives listed in Section 1.3. This combination method also meets Council Policies, notably the Auckland Water Strategy (2022-2050) and Te Tāruke-Ā-Tāwhiri: Auckland's Climate Plan. The Glyphosate and organic herbicide option, also reduces the potential for herbicide resistance among weed species in comparison to a single herbicide application. The only negative is that this combination does have the higher potential risk to freshwater in comparison to thermal and mechanical methods due to runoff potential relating to the number of applications required.

On the balance of criteria and the objectives established by the resolution of the climate change committee resolution, and the fact that Glyphosate alone and mechanical alone, or in combination, are not acceptable for policy or cost reasons the combination of organic herbicide emerges as the most appropriate option. It will reduce glyphosate usage across Auckland with the largest local board areas in the South and the West. Water usage, CO_{2e} emissions area also far lower than any of the thermal options and it has the second lowest per/km cost.

In the absence of the broader investigation identifying any new methods for inclusion in the options analysis, and Morphum undertaking an independent review based on updated information, it is worth noting that the conclusion regarding the most suitable method i.e. combination method of organic herbicide and glyphosate, aligns with conclusion and recommendation of the preceding investigation. This combination is therefore recommended for consideration in the standardised funding model.

6.9. Recommendations

Seven recommendations have been provided to support improved understanding and ongoing progress towards best practice.

1. Enforcement and monitoring of contractor spraying programmes to ensure runoff potential for chemical treatment methods are reduced. This includes both wind and having clear weather windows where predicted precipitation is less than five millimetres within a six-hour period.
2. Understanding the environmental concentration of herbicides within Auckland's waterways could assist in confirming the nature and scale of the impact of chemical weed management on receiving freshwater environments.
3. Iwi preferences did not inform the options despite the Councils efforts in this regard. Iwi did however indicate that the draft recommendations be presented to them for comment before circulation to local boards. Given that consideration of cultural perspectives was a specific requirement of the Climate Change Committee resolution, and the required level of input was not received, it is recommended that this report is presented to with mana whenua, as per their expectation.
4. Continuous investigation into organic and synthetic herbicides as new products enter the market. Should a viable option be developed, that will meet the contractual specifications, policies and legal frameworks and be scientifically proven to be less eco-toxic than current organic and synthetic herbicides then it should be implemented.

5. Improved consideration or better alignment with other interventions, notably street sweeping, to reduce the leaf and sediment build up that supports weed growth.
6. Maintain curb and pavement renewal programmes to minimise sites (cracks) for weeds to establish.
7. Broader public education on the use herbicides and communication that are both organic and synthetic as both have adverse effects.

Table 12: Options Analysis results including all factors assessed.

	Option	Application Ratio	Combined Score	Overall Ranking	Emissions per km kg CO _{2e}	Emissions Ranking	Water L/km/yr	Water Ranking	Freshwater Risk L/km/yr	FW Ranking	Operator HS	Operator HS Ranking	Public HS	Public HS Ranking	Cost per KM	Cost Ranking
1	Glyphosate	5	15.5	1	0.97	3	180	3	1.8	6	2.50	2	2.33	2		1
2	Organic herbicide	7	22.17	5	1.36	4	1350	5	13.5	10	2.17	1	2.83	4		3
3	Mechanical- tool-weedwhackers	12	22.5	2	0.69	1	0	1	0	1	2.50	2	3.67	7		10
4	Thermal (Hot water or Steam)	12	32.5	8	19.22	10	6545	10	0	1	2.50	2	1.83	1		8
5	Combo 1: Glyphosate + Organic Herbicide	3:4	20	4	1.36	4	915	4	8.79	9	2.50	2	2.83	4		2
6	Combo 2: Glyphosate, organic herbicide and thermal	3:3:3	26	6	5.39	6	2323	6	6.87	7	2.50	2	2.83	4		4
7	Combo 3: Glyphosate and Mechanical	3:6	24	3	0.93	2	108	2	1.08	4	2.50	2	3.67	7		7
8	Combo 4: Glyphosate and thermal	3:6	31	7	10.19	9	3381	9	1.08	4	2.50	2	2.33	2		5
9	Combo 5: Zero Chemical (Mechanical and thermal only)	6:6	35	9	7.48	8	3273	8	0	1	2.50	2	3.67	7		9
10	Combo 6: Organic herbicide, thermal and mechanical	4:3:3	33	10	5.45	7	2760	7	7.71	8	2.50	2	3.67	7		6

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Appendix 1 2022 Contractual Specifications for Weed Management in Urban Area.

Schedule 1a

GENERAL SPECIFICATION

**Urban Streetscape Edging
and Weed Management**

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General Specification

1. General Requirements

- 1.1 This schedule sets out the requirements and standards for the inspection and management of the Agreement weeds and edging on or adjacent to assets and surfaces within the urban road corridor within the EXTENT OF WORKS. (clause C1 Schedule 1b and 1c – Technical Specification).
- 1.2 This schedule is supplemented by the Schedule 1b Outcome Technical Specifications - Urban Streetscape Edging and Weed Management and Schedule 1c Performance Technical Specifications- Urban Streetscape Edging and Weed Management, which will provide additional guidance to best practice methodologies or site-specific technical requirements.
- 1.3 The Supplier must always comply with all standards; in this schedule, in the Schedule 1b -Outcome Technical Specifications and in the Schedule 1c -Performance Technical Specifications.
- 1.4 This General Specification (Schedule 1a) and the Technical Specifications (Schedule 1b & Schedule 1c) shall be read in conjunction with Schedules 2-10 – Urban Streetscape Edging and Weed Management and the Specific Terms and the General Terms.
- 1.5 The Supplier will act as the 'Eyes and Ears' of the Principal and proactively identify and report issues not just exclusively in relation to the scope of works within this contract but also any issues in relation to the general delivery of services within the EXTENT OF WORKS.
- 1.6 The Supplier shall have a strong culture of continuous improvement.
- 1.7 The Supplier is expected to perform all requirements of the contract, whether expressly specified or otherwise, in accordance with the responsibility and scope of maintaining these assets.

2. Performance of Services

- 2.1 Performance of the Services shall be undertaken and warranted in accordance with clause 10.2 Performance of Services – General Terms.
- 2.2 It is the responsibility of the Supplier to supply all services including, but not limited to, all personnel, plant and equipment, materials, traffic management, other resources and overheads required to deliver service tasks fully and to the required standards required by this General Specification, the Technical Specification, and Agreement
- 2.3 It is the responsibility of the Supplier to integrate their own management and reporting systems with Council systems required to maintain the Principal's Sites to the standards required by this General Specification, the Technical Specification, and Agreement.

3. Service Tasks

3.1 The tasks required under this contract are as follows:

- (a) General administration and communication;
- (b) Site inspections and visits;
- (c) Development of annual work programmes;
- (d) Development and implementation of monthly work programmes;
- (e) Site operations:
 - (i) Edging;
 - (ii) Weed Management;
 - (iii) Site clean-up of weed material.
- (f) Repair, replacement, or reinstatement of asset damage resulting during completion of contract operations.
- (g) Management and reporting of contract information in a timely manner, including but not limited to, work programmes; contract compliance; service delivery; financial performance, quality assurance and contract development.
- (h) Meetings and workshops.
- (i) Asset inventory management in accordance with Council's information technology and Business to Business (B2B) information management requirements, processes, and standards.

4. Legislation, Compliance and Consents

- 4.1 The Supplier shall comply with all applicable laws, regulations, bylaws, industry codes of practice, Local Board requirements, ethical and professional standards and licensing and consenting requirements in accordance clause 3.2 Supplier's obligations (d) and clause C3.1 Compliance – General Terms, Schedule 1b -Outcome Technical Specifications and in the Schedule 1c -Performance Technical Specifications.
- 4.2 All references to legislation shall be in accordance with the prescribed definition of Legislation (clause 1.1 Definitions – General Terms).
- 4.3 In accordance with clause 10.2 Performance of Services clause (d) ii Supplier's obligations – General Terms, the Supplier shall represent, warrant, and perform services that will not cause the Principal of Supplier to be in breach of any law or third-party rights.
- 4.4 The Supplier shall deliver services in accordance with Council's applicable workplace policies (clause 3.2 (d) ii Supplier's obligations – General Terms).
- 4.5 The Supplier shall confirm that consents have been obtained for all programmed work(s) before any works can occur.
- 4.6 Upon discovery of any breach of any legislation, bylaws, policies, or consents, or specified Local Board work treatments by the Supplier's staff, the Supplier shall immediately notify the Principal and inform the personnel concerned that the activity must cease.

5. Materials, Plant and Equipment and Workmanship

- 5.1 In accordance with clause 3.2 (b), (c) Supplier's obligations and clause 10.2 (a) Skills; (c) Fit for purpose the Supplier shall perform the Services under this agreement with a level of care, skill, diligence, and judgement expected from an experienced Supplier by only using 'fit for purpose' vehicles, plant and equipment and systems and appropriately qualified, skilled, and experienced personnel who hold all required licences and consents.
- 5.2 Should any inspection by the Principal find evidence of non-conforming workmanship or results at variance with the Supplier's Quality Assurance Plan the Supplier, on request from the Principal, shall supply within one (1) working day a written explanation for the variance and details of what remedial action has been taken to rectify the situation.
- 5.3 Defective or non-compliant services shall be rectified in accordance with clause 11.2 Defective services – General Terms.
- 5.4 The Supplier shall select the appropriate plant, equipment, and vehicles for safe and efficient completion of contract operations.
- 5.5 All plant, equipment and vehicles shall be registered for normal use on the highway unless otherwise approved by the Principal.
- 5.6 The Supplier shall also ensure that any vehicles or plant and equipment used during the Agreement are well-maintained and presented in a clean and tidy condition. The Supplier shall provide maintenance records to the Principal upon request.
- 5.7 Plant, equipment, and vehicles leaking oil or fuel shall be removed immediately from site and not used until the problem is rectified to the satisfaction of the Principal.
- 5.8 Branding/Supplier Identification
- (a) The Supplier shall identify itself as working for Auckland Council as follows:
 - (i) Clear signage attached to all vehicles shall identify Auckland Council's logo, goals and principles at the discretion and satisfaction of the Principal;
 - (ii) Uniforms marked with the Supplier's logo on the left side of the chest area and the Auckland Council logo on the right side of the chest area of all upper parts of uniforms.
 - (b) Branding/Supplier identification shall be in accordance with 'Our Brand – Auckland Council Brand Manual Chapter 4 - Uniforms and Clothing and Chapter 5 – Vehicles.
 - (c) The Supplier shall meet all reasonable costs associated with Branding/Supplier Identification.
- 5.9 If working in a public area, at the end of each workday the work site shall be left clear of materials, plant and equipment and vehicles so that it is safe for use by the public.

6. Working Hours

- 6.1 The standard working hours are 7am – 6pm (52 weeks of the year); and on Saturdays and Sundays and statutory holidays, between the hours of 10am – 6pm.
- 6.2 Timing of activities during standard working hours shall avoid creating nuisance or noise (clause 6.4) for public or residents or restrict use of, or around sites, particularly during high use periods.

- 6.3 Work outside of standard hours shall only be undertaken following approval of the Principal.
- 6.4 The Supplier shall ensure that Services that generate excessive noise or other hindrances are carried out at times that minimise the impact to the public and residents and comply with any relevant bylaws and/or specific noise restrictions. The Supplier may, in some locations of the site, be restricted by law, regulation or otherwise in the times it can access the site to carry out the Services. The Supplier shall comply with all such time restrictions and may be required to work outside the normal working hours as specified to comply with such restrictions in a manner best likely to further the Principal's objectives for the Services (clause 3.2 (e) Supplier's obligations – General Terms). The cost of working within these restrictions shall be included in the Supplier's price
- 6.5 The Supplier shall always take into account likely high public use of and around the sites and be aware of associated conditions or circumstances that may prevail during peak use periods including, but not limited to:
- (a) outside educational, day care or community facilities and associated walking school bus routes during hours these institutions are in use, namely 7.30am – 4.30pm on the days the facilities are operating.
 - (b) Near shops, high use walkways, arterial roads, and bus stops during peak use periods.
- 6.6 The Principal shall have the right to restrict certain activities to defined periods without any additional payment to the Supplier (e.g., night works). To avoid doubt, if the Principal advises the Supplier that certain Services must be performed at specified times, the Supplier must perform those Services at those specified times in a manner best likely to further the Principal's objectives for the Services (clause 3.2 (e) Supplier's obligations – General Terms, even if those times are outside working hours. The Supplier will not increase its price for work undertaken outside working hours.
- 6.7 No contract works shall be executed within these hours except for the purpose of attending to emergency work, or as specifically requested or approved by the Principal's Representative.

7. Contract Works

- 7.1 In accordance with clause 3.2 Supplier's obligations – General Terms, clause 3.4 Personnel (a) – General Terms and clause 10.2 Performance of services (a) skills – General Terms, the Supplier shall commit sufficient be trained, qualified and competent personnel to undertake all aspects of the Contract Works including but not limited to:
- (a) Exercise good industry practice in providing the Contract Services and the Supplier's obligations under this Contract; and
 - (b) Provide the Contract Works in a proper, safe, timely and competent manner within the agreed timeframes
 - (c) Act as the 'Eyes and Ears' of the Principal and proactively identify and report issues not just exclusively in relation to the scope of works within this contract but also any issues in relation to the Principal's general delivery of services. Without limiting the foregoing, the Supplier must report any illegal dumping, repairs and required renewals, and report to the Principal and the relevant authority any dangerous, damaged, sub-standard, or otherwise not fit for purpose infrastructure within the carriageway as a duty of care.

- 7.2 The Supplier shall ensure that all personnel performing prescribed chemical application work, or are suitably qualified, in accordance with clause C3.2.1 Management & Applicator Qualifications – Schedule 1b -Outcome Technical Specifications and in the Schedule 1c -Performance Technical Specifications.
- 7.3 The Supplier shall ensure that all personnel are qualified to carry out work on the relevant road or state highway and have been trained to work on the Traffic Systems Equipment.
- 7.4 The Supplier shall ensure that all personnel have the appropriate technical plant and equipment to carry out the contract services including all relevant traffic management equipment provided to create an initial safe work environment.
- 7.5 The Supplier shall respond to requests for Reactive Response Works (RFS) 24 hours per day, 7 days per week (Schedule 3 Work Management).

8. Supplier's Operational Manager

- 8.1 The Supplier shall use the Key Persons (clause 3.4 Key Person – Specific Terms) and clause 3.4 Personnel – General Terms to perform the Services.
- 8.2 In accordance with clause 10.2 Performance of the services (a) skills – General Terms, the Supplier shall provide an appropriate representative and supporting management structure to oversee contract management, to provide customer service and public relations (including conflict resolution) and to liaise with the Principal and the public.
- 8.3 All responsibilities of the Supplier's Operational Manager will be provided in accordance with Schedule 4 – Price and Basis of Payment (Management Fee).
- 8.4 The Supplier's Operations Manager shall be suitably qualified (clause C3.2.1 Management & Applicator Qualifications – Schedule 1b -Outcome Technical Specifications and in the Schedule 1c -Performance Technical Specifications or equivalent) and experienced; minimum 5 years practical experience in weed and pest plant management.
- 8.5 The Supplier's Operations Manager shall have a high level of competence to achieve the responsibilities and tasks listed in clause 10.5.
- 8.6 The Supplier's Operations Manager responsibilities shall include, but are not limited to:
- (a) Champion Supplier performance in the context of the Agreement objectives and outcomes.
 - (b) Oversee health & safety, risk management and compliance
 - (c) Oversee development and management of Work Programmes, ensuring the correct level of resource is allocated to support full and efficient service delivery.
 - (d) Complete work programme requests for change during the month (as required).
 - (e) Be the first point of contact for and manage all Reactive Response (RFS) works;
 - (f) Display a high standard of technical competence when developing and implementing work programmes in accordance with current weather conditions;
 - (g) Manage quality assurance;
 - (h) Oversee environmental management;
 - (i) Champion community outcomes and workforce development
 - (j) When requested, accompany the Principal or the Principal's Representative to site inspections, visits, Council or Local Board meetings and workshops;

- (k) Prepare weed control reports if requested by the Principal.
- (l) Liaise with the Principal, or Principal's representative, public and stakeholders as required to fulfil all contract management requirements;
- (m) Develop a close working relationship with the Principal's Representative and fully, openly, consistently, and promptly brief or escalate to the Principal any matters about performance of services that are contentious or affect the Council or stakeholder interests using a philosophy of 'no surprises' and early warning (clause 4.3 No surprises – General Terms).

9. Supplier's Weed Management Personnel

- 9.1 The Supplier shall use the Key Persons (clause 3.4 Key Person – Specific Terms) and clause 3.4 Personnel – General Terms to perform the Services.
- 9.2 Work(s) shall only be completed by suitably qualified (clause C3.2.1 Management & Applicator Qualifications Schedule 1b -Outcome Technical Specifications and in the Schedule 1c -Performance Technical Specifications or equivalent) and experienced (minimum two (2) years practical experience within the amenity horticultural industry including relevant skills for weed management (clause 10.2 Performance of the services (a) skills – General Terms).
- 9.3 Each weed management team shall be supervised by a Team Leader who will manage on-site health & safety and environmental compliance, liaise with public (in the absence of the Supplier's Representative), deliver the work programme and oversee technical quality standards.
- 9.4 The Team Leader shall be suitably qualified ((clause C3.2.1 Management & Applicator Qualifications – Schedule 1b -Outcome Technical Specifications and in the Schedule 1c -Performance Technical Specifications or equivalent) and experienced (minimum 3 years practical experience within the amenity horticultural industry including relevant skills for weed management), have a high level of technical competence and show a high level of initiative.
- 9.5 All personnel shall have been inducted in the outcomes of the contract and the maintenance treatments specified, along with the daily data update requirements to ensure the Suppliers obligations are fully met (clause 3.2 Supplier's obligations – General Terms).

10. Personnel Behaviour and Appearance

- 10.1 The Supplier shall be responsible for maintaining good relations with the public on behalf of the Principal (clause 4.4 Publicity and reputation – General Terms) and use a common-sense approach with a professional attitude when dealing with all stakeholders and be polite, friendly, and courteous to members of the public.
- 10.2 The Supplier shall achieve the following customer service standards:
 - (a) Staff members accept responsibility for handling queries and passing on matters to relevant people as appropriate.
 - (b) No matters are left unresolved.
 - (c) Staff members return calls as and when promised.
 - (d) Staff members are courteous and helpful and refer queries to the relevant person to respond.
 - (e) Staff members refer policy matters to the Engineer.

- (f) The Contractor always protects the Principal's reputation, both on and off the Contract Works.
- 10.3 The Supplier shall have systems and processes in place and provide staff training in the management of conflict or angry or aggressive members of the public.
- 10.4 The Supplier shall be responsible for taking care and being seen to be taking care when maintaining vegetation, assets, and infrastructure in the vicinity of the work site to meet the service requirements of the public and the Principal in accordance with clause 3.2 Supplier's obligations – General Terms and clause 10.2 Performance of the services (a) skills – General Terms.
- 10.5 The Supplier shall ensure that all personnel are tidily and appropriately attired when carrying out the Services and are clearly identified as being engaged by the Supplier (branded uniform, identification badge or business card).
- 10.6 Supplier staff shall be conversant with relevant Council Policies and by-laws (refer clause 4 – Legislation, Compliance and Consents).
- 11. Site Access**
- 11.1 If site access is considered likely to result in damage to any Council asset, above or below ground services or private property then works shall not be initiated without consultation with the Principal (except for works immediately necessary to safeguard persons or property).
- 11.2 The Supplier shall undertake a 'before you dig' assessment for works requiring excavation.
- 11.3 The Supplier shall obtain written approval of the adjoining landowner before private property is accessed.
- 11.4 The Supplier shall assess ground moisture conditions before allowing vehicles to travel across turf surfaces and evaluate passage of vehicles across hard surfaces prior to accessing to prevent or minimise asset damage when accessing a site.
- 12. Asset Care, Damage, Reinstatement and Repair**
- 12.1 The Supplier shall ensure that no damage is caused to Council or private property trees, vegetation, turf, hard surfaces, facilities, road corridor assets, or private property by contract operations.
- 12.2 Where assets are damaged, the Supplier shall photograph the damaged asset (date and time stamp) before and after reinstatement, repair, or replacement. In the case of a dispute arising from a damaged

asset and in the absence of clear 'before and after' photographic evidence, the Supplier will be required to repair, reinstate, or replace the asset at its own cost.

- 12.3 The Supplier is advised that any use of the natural water is subject to the provisions of the Resource Management Act (1991) and the Supplier shall ensure any use of natural water has been approved by the Principal.
- 12.4 Where contract works cause a damage or disruption, the reinstatement methodology shall be discussed with and approved by the Principal.
- 12.5 The Supplier shall rectify at its own cost any damage caused by working during unsuitable conditions, with unsuitable plant and equipment or by incorrect methodology or operator error.
- 12.6 Any damage to assets shall be reported to the Principal within twenty-four (24) hours of incidence.
- 12.7 If the Supplier does not rectify the asset damage, the Principal may reduce the Price payable for services and/or rectify or engage another person to repair or reinstate damage at the cost of the Supplier in accordance with clause 11.2 Defective services – General Terms.
- 12.8 The site or asset shall be reinstated or repaired to a condition at least equivalent to that existing at time of work commencement. This shall include 'before' and 'after' photographs of the asset damage and the reinstatement or repair.

13. Hazardous Waste Dumping

- 13.1 Hazardous waste is defined as waste that has substantial or potential threats to public health or the environment and typically includes waste that is:
- (a) Flammable
 - (b) Toxic
 - (c) Corrosive
 - (d) Explosive
 - (e) Radioactive
- 13.2 Common types of hazardous waste include, but are not limited to, most chemicals, paint, acid, and gas cylinders.
- 13.3 The Supplier shall immediately make the site safe and report any / all hazardous dumping to Auckland Council's Pollution Hot Line (ph.: 09 377 3107).
- 13.4 No further action shall be taken unless requested by the Principal.

14. Storage and Disposal of Material

- 14.1 The Supplier shall make provision (clause 3.5 Responsibility – General Terms), at its own cost (clause 5.9 No other payment – General Terms), for the stockpiling or storage of any materials, plant and equipment or any other matter. The Supplier shall be responsible for the protection of all onsite materials, equipment, and possessions and as necessary store the Principal's materials separate to others.
- 14.2 Except where materials are stored temporarily and will be applied or used within the working week, no materials, plant, or equipment shall be stored by the Supplier at the site without the prior written consent of the Principal.
- 14.3 No excess materials, refuse, detritus, vegetation, clippings, or other by-product of the Supplier carrying out the Services shall be disposed of at the site. The contract price shall be deemed to allow for all the costs

associated with disposal including transport, loading, unloading and tip fees and any other costs associated with compliance with disposal requirements.

15. Machinery / Materials Storage

- 15.1 Machinery and materials may be stored on car parks with written permission from the Principal. However, the Principal accepts no responsibility for any incidences of machinery damage or theft (clause 3.5 Responsibility – General Terms).
- 15.2 The Supplier will not be able to change the accessibility to the Principal's Sites without the written approval of the Principal.
- 15.3 Where storage is being undertaken on the Principal's Sites and members of the public are present, the Supplier will ensure that such work is undertaken in a manner that does not obstruct or interfere with normal use of the site.

16. Unauthorised Use

- 16.1 Where the Supplier becomes aware of illegal or unscheduled use of Principal's Sites, they are to report this to the Principal immediately (clause 4.4 Publicity and reputation (a) disrepute – General Terms).

17. Temporary Exemption from Standards – Unforeseen Circumstances

- 17.1 In accordance with clause 14 Unforeseen Circumstances – General Terms, the Supplier shall request a temporary exemption from contract standards, as soon as practicable after identifying the factors outside the Supplier's control preclude the performance standard being achieved. The period of any exemption granted will be at the discretion of the Principal.
- 17.2 Where the Supplier seeks an exemption from these specifications, adequate evidence in support of the application must be produced, clearly indicating that all possible avenues to meet that standard have been explored and attempted.
- 17.3 A request for, or the granting of an exemption does not preclude the Supplier from immediately meeting the performance standard when conditions return to normal.

18. Civil Defence, Emergency and Adverse Events

- 18.1 Upon notification of an emergency event or adverse event the Supplier is to immediately inspect and make safe the affected property until permanent repairs are undertaken. The Principal reserves the right to bring in separate Suppliers during an emergency event or adverse event.
- 18.2 The Principal may also request that labour, plant, and equipment resource additional to that used to for contract service delivery be provided by the Supplier (by drawing on resources from other contracts or contract locations)
- 18.3 The Supplier shall be paid for this additional resource at rates included in Schedule 4 – Price and Basis of Payment.
- 18.4 Should attendance at an emergency incident have a noticeable impact on the Supplier's contractual performance, options are to be negotiated by the Principal and the Supplier, to bring the Supplier's contractual performance back to within the specified standards. The intent of these negotiations is that the Supplier should not be financially disadvantaged or penalised because of responding to a civil defence, emergency event or adverse event.

18.5 The Supplier shall make available key staff to participant as required with any Civil Defence event or exercise.

19. Biosecurity

19.1 The Supplier shall comply with the Principal's current Kauri Die Back Hygiene Standard Operating Procedure (SOP), amendments or 'it's replacement'.

20. Costs Associated with General Specifications

20.1 All costs associated with complying with this General Specification are included in the rates in Schedule 4.

21. Threatened Plants

21.1 The Supplier must take all practicable steps to prevent the damage or destruction of endangered plant species

21.2 A list of endangered/threatened species will be provided at the award of the contract.

21.3 Damage to endangered plant species shall be reported and remediated in accordance with clause 12 – Asset Care, Damage, Reinstatement & Repair.

22. GPS Monitoring

22.1 The Supplier shall ensure that all vehicles which are engaged in delivery of contract services carry a web-based GPS tracking system to demonstrate to the Principal when and where Maintenance Works have been undertaken.

22.2 As a minimum, the vehicle monitoring shall include:

- (a) pump and plant engagement tracking.
- (b) ignition, commencement of vehicle/plant moving, stopping of vehicle, any speeding events, arrival on site, departure from site.

22.3 The tracking system shall be able to produce journey reports in map format in real time when requested by the Principal including:

- (a) Date
- (b) Times including length of stay.
- (c) Location coordinates
- (d) Vehicle identification

22.4 These reports shall be made available to the Principal on request.

22.5 On request, the Supplier shall provide similar reports on any other plant or equipment including handheld devices that are GPS enabled and traced by the Supplier.

23. Asset Information

- 23.1 The Supplier shall verify asset varied into the contract (all asset fields) at the time of the first maintenance visit.
- 23.2 Where the Supplier notices items in the data inventory that are incorrectly attributed, not included in the inventory, are missing in the field or are at an alternate location the Supplier is to advise the Principal.
- 23.3 The scope of asset information updated or collected may be changed from time to time at the direction of the Principal.

24. Affected assets

- 24.1 Six weeks prior to the Commencement Date, the Supplier shall undertake due diligence on all Assets to identify the Assets that are **materially** out of Specification.
- 24.2 The Supplier shall provide a comprehensive list of those Assets (Affected Assets) to the Principal no later than 4 weeks prior to the commencement of this contract.
- 24.3 The list shall be approved at the discretion of the Principal.
- 24.4 The Asset Solutions are likely to include a combination of:
- (a) Scheduled maintenance where the Asset Specification can be achieved over time. Where additional costs are incurred by the Supplier for this regular planned maintenance, they will be agreed in advance and charged to the Principal, subject to the parties agreeing a variation.
 - (b) One-off projects to bring certain Affected Assets (or Affected Assets within high-profile areas) to within the Asset Specification. These one-off projects will be funded by the Principal, subject to the parties agreeing a variation.
 - (c) The Supplier must implement an Asset Solution for an Affected Asset promptly after it is agreed.
- 24.5 If requested by the Supplier, the Principal will, on an Asset-by-Asset basis, waive the requirement for the relevant Affected Asset to meet the Gateway 2 Quality KPIs for a reasonable period (considering the nature of the Asset and its condition).
- 24.6 An Asset will no longer be an Affected Asset once it meets the Asset Specification.
- 24.7 No Asset will be an Affected Asset (and the Supplier is not relieved from performance of any Services, Contract Performance KPIs or Service Levels in respect of any Asset) unless it is identified as an Affected Asset in the list provided by the Supplier and approved by the Principal on or before the date required under this clause

25. Support Asset Planning

- 25.1 The Supplier must assist the Principal in conducting its asset planning activities in a proactive and efficient manner to maintain sustainable delivery of the contract outcomes.
- 25.2 The Supplier's responsibilities include, without limitation:
- (a) Notifying the Principal of any Assets that are difficult or high cost to maintain;
 - (b) Advising on the best approach to maintaining consistent levels of service for the respective work types to ensure that all weeds and edging vegetation in the road corridor, on average, are maintained appropriately to maximise road safety and contract amenity values;

- (c) Providing advice on modification or development of the technical specifications to facilitate innovative delivery of weed management and edging works in accordance with best industry practice so that services are delivered cost effectively and to the agreed standard; and
- (d) Reporting to the Principal on other Asset management activities. The exact detail of the content, format and distribution of the respective analyses may vary over time and are to be agreed with the Principal.

DRAFT

SCHEDULE 1b – OUTCOME TECHNICAL SPECIFICATION

Urban Streetscape Edging & Weed Management

Urban Road Corridor Town Centres (A)

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A DEFINITIONS

Item	Definition
Agrichemical	Agrichemicals are chemical products used in agriculture, including herbicides.
Boundary	A line which marks the limits of an area.
Carriageway	'The Carriageway' is defined as the road surface from the edge of the channel to the centre line.
Channel	'Channel' is defined as the surface water drain extending from a hard surface or natural edge.
Cycleway	'Cycleway' is defined as a hard surface which is legally designated for dedicated cycling or is a shared path for cyclists and pedestrians (generally identifiable through traffic control measures such as, but not limited to, signage or road markings) as informed by the asset data.
Edging	Control of grass and weeds encroaching onto a hard surface or asset either horizontally or vertically, carried out as per the specifications
Footpath	'Footpath' is defined as any walkway, service lane or shared space.
Hard Surfaces	'Hard Surfaces' are defined as surfaces that include but are not limited to cycleways, special vehicle lanes, footpaths, paved areas, tracks and other paths, business frontages, entrances to the front door of a business, on-road car parks, off road carparks, median strips, catch-pit grates, backing plates, traffic islands, speed humps, speed tables, kerbing, bridged channels, roundabouts, shared spaces, and kerb and channels including the road carriageway.
Herbicide	A product used to destroy or inhibit plant growth of weeds.
No Spray Register	Register containing the names and addresses of property owners or residents who have requested that agrichemicals are not used on the road frontage of the road corridor and also require notification prior to spraying operations being undertaken in proximity of the property
Organic Herbicide	A 'plant-derived' oil-based, acetic acid based or fatty acid-based weed control product.
Response Work	'Response work' (Schedule 3) refers to reactive response work (RFS) generated by customers, Auckland Council, or the Supplier.
Road Corridor	The 'Road Corridor' has the same meaning as road in the Local Government Act 1974 (Section 315) and is defined as the complete area from boundary to boundary including the boundary itself. It encompasses the carriageway (formed road), road surface, kerb and channelling, city and town centres, berms, shoulders, footpaths, cycleways, cycle paths, traffic islands, surface water drains, pleasure areas, bridal paths, land that is legally designated as road but is not currently formed as carriageway or footpath (legal road, unformed road, or paper road), street to street walkways and carparks.
Shared Space	'Shared Space' is where the traditional distinction between footpath and road has been removed so that vehicles, pedestrians, and cyclists can share the space (the space is maintained to footpath specification).
Shoulder	'Shoulder' is defined as the gravel area on the side of the carriageway which is normally from the carriageway to the bottom of the swale drain. In the urban areas these are typically located in the transition area from rural to urban zones and along carriageways without a formed kerb.
Spraying	Control of weeds by use of liquid products including agrichemicals and organic herbicides.
Street Furniture	'Street Furniture' is defined as any asset fixed within the road corridor such as but not limited to a bus shelter, litter and recycling street bins, seats, parking meters, bollards, sight rails, railings, fences, handrails, in-ground lights, cycle - rails stands and racks, pedestrian safety fences and crossing barriers, structures, glass panels, traffic aids or structures including, service lanes or shared spaces, any concrete pads and foundations for furniture items if present.
Street Tree	Tree located within the road corridor, on the grass verge or berm, or occasionally within the paved part of public roads, shared or civic spaces.
Weed	'Weed' is defined by the Auckland Council Weed Management Policy as any plant or part of a plant growing where it is not wanted and which may have an adverse effect on people, Māori cultural values, infrastructure, other built assets, or the natural environment. Weeds include, but are not limited to, pest plants identified in the Auckland Regional Pest Management Strategy (RPMS).
Weed Management	'Weed management' is the control of weeds in the road corridor in accordance with the technical specifications.

B – Contract, Technical & Contract Management Outcomes

B1.1 Contract Outcomes

Contract Outcomes	
1.	Road corridors are safe and aesthetically pleasing and asset life is not compromised by weed management.
2.	Weeds do not damage road surfaces or road assets.
3.	Weeds do not impede the flow of drainage water.
4.	Town centres are tidy, well-maintained, and aesthetically pleasing.
5.	Industry standards, legislative requirements and Auckland Council Plans and Policies are adhered to.
6.	Agreed sustainability and environmental innovation targets are implemented.
7.	Supplier adopts and implements environmentally sustainable treatment methodologies (where practicable and without compromising methodology effectiveness).

B1.2 Technical Outcomes

KPI No	Technical KPI	Agrichemical	Organic Herbicide	Mechanical	Thermal	Low Carbon
B1.2.1	• Weeds and edge dimensions less than maximum specified heights, widths, and encroachment widths.	✓	✓	✓	✓	✓
B1.2.2	• Weed growth (height or width) not compromising the visual appearance of the location (even if individual weed heights and widths are less than the maximum heights, widths, or asset encroachment widths).	✓	✓	✓	✓	✓
B1.2.3	• Auditing informed by die back and control guidelines and specified tolerances.	✓	✓		✓	✓
B1.2.4	• No unapproved products or methodologies used.	✓	✓		✓	✓
B1.2.5	• No non-target vegetation asset damage or infrastructure asset damage.	✓	✓	✓	✓	✓
B1.2.6	• No locations or assets on the 'No Spray Register sprayed'.	✓	✓			
B1.2.7	• No spray dye marker used (unless approved).	✓	✓	✓	✓	✓
B1.2.8	• No cut weed debris left on site.	✓	✓	✓	✓	✓

B1.3 Contract Management Outcomes

KPI No	Technical KPI
B1.3.1	<ul style="list-style-type: none"> The full extent of contract locations and assets maintained.
B1.3.2	<ul style="list-style-type: none"> Weed control and edging not undertaken on road corridor berms maintained by property owners or occupiers (where these areas are in alignment with the technical specification clearance targets and outcomes).
B1.3.3	<ul style="list-style-type: none"> Supplier personnel applying agrichemicals and organic herbicides are qualified.
B1.3.4	<ul style="list-style-type: none"> Agrichemicals and organic herbicides stored and handled in accordance with good management practices.
B1.3.5	<ul style="list-style-type: none"> Implementation of work programme considers restrictions for educational, day-care and community facilities, peak use periods for shops, bus stops, walking school bus and main arterial routes.
B1.3.6	<ul style="list-style-type: none"> All plant and equipment safe and support effective weed and edge control.
B1.3.7	<ul style="list-style-type: none"> Agrichemicals and organic herbicides applied in strict accordance with the Manufacturers' recommendations.
B1.3.8	<ul style="list-style-type: none"> Asset damage fully reinstated or repaired at Supplier's cost to at least original condition.
B1.3.9	<ul style="list-style-type: none"> No Spray Register adhered to and public notification of properties on 'No Spray' Register completed in accordance with notification timeframes.
B1.3.10	<ul style="list-style-type: none"> Glyphosate used a maximum of 3x annually in the specified months for combined (agrichemical/organic herbicide treatments).
B1.3.11	<ul style="list-style-type: none"> No validated contamination of storm water network resulting from contract operations.

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C – Urban Streetscape Edging & Weed Management - Outcome Technical Specification

Clause	Clause Component	Extent of Works	Specification	Technical Outcome(s)
C1 Extent of Works	C1.1 – Extent of Works	All Scheduled Urban Road Corridor and Town Centre (A) Locations & Assets	<p>Weed management and edging shall include all weeds appearing in or on hard surfaces or encroaching over surfaces or edges or assets (e.g., street furniture) in the road corridor or town centre from boundary to boundary (including the boundaries). The extent of works shall include all sealed, concrete, or unsealed areas including, but is not limited to:</p> <ul style="list-style-type: none"> • road carriageway surface • bridge decks • shoulders • structure foundations • catchpits, drains, manholes • culverts & open drains • pavement edges • kerb and channel • footpaths, walkways and accessways • service lanes • carparks • cycle lanes and cycle paths • expansion and construction joints • Street Furniture (e.g., lighting poles, power and telephone poles, telecommunication pillars, service boxes, utility cabinets; and other fixings regarded as street furniture) • traffic signs and edge marker posts • tree circles. <p>The Supplier shall not maintain weeds and edges on berms maintained by private property owners or occupiers (where these areas are in alignment with the technical specification clearance targets and outcomes).</p>	<p>Extent of Works</p> <ul style="list-style-type: none"> • The full extent of contract locations and assets maintained. • Weed control and edging not undertaken on road corridor berms maintained by property owners or occupiers (where these areas are in alignment with the technical specification clearance targets and outcomes).

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C – Urban Streetscape Edging & Weed Management – Outcome Technical Specification

Clause	Clause Component	Extent of Works	Specification	Technical Outcome(s)																								
C2 Weeds and Edging	C2.1 Weed Management Targets (Road Corridor)	All Road Corridor Asset and Locations	<p>Weeds</p> <p>The Supplier shall manage weeds within the Road Corridor at heights and widths less than the</p> <ol style="list-style-type: none"> maximum height or maximum width in Table 1 (below). <p><i>Table 1 – Maximum Weed Management Clearance Targets – Road Corridor</i></p> <table border="1"> <thead> <tr> <th>Level of Service</th> <th>High Profile</th> <th>Medium Profile</th> <th>Low Profile</th> </tr> </thead> <tbody> <tr> <td>Work Treatment</td> <td colspan="3">Agrichemical (Glyphosate); Organic Herbicide, Organic Herbicide + Agrichemical (Glyphosate), Thermal, Innovation</td> </tr> <tr> <td colspan="4">Weed Management – Road Corridor (including Tree circles on non-maintained berms)</td> </tr> <tr> <td>Maximum weed Height OR Width</td> <td>50mm</td> <td>100mm</td> <td>125mm</td> </tr> <tr> <td>Audit Tolerance Minor and non-material missed weed treatment in Road Corridor</td> <td colspan="3"> <ul style="list-style-type: none"> ✓ Permitted - Minor miss of standalone weeds (<5 weeds per 100 linear metres). * Not Permitted - Patches comprised of multiple weeds. * Not Permitted - Repeated pattern of missed standalone weeds. </td> </tr> <tr> <td>Audit Tolerance Number of linear metres of continuous carpet of weeds of any dimension per 100 linear metres of road corridor.</td> <td colspan="3"> <ul style="list-style-type: none"> ✓ Permitted - Minor miss of continuous weed carpet (<5 linear metre continuous carpet per 100 metres). ✓ Permitted – Minor miss of continuous weed carpet (<1 linear metre on a traffic island, or in a crack in road or kerb surface). * Not Permitted - Repeated pattern of continuous weed carpet. </td> </tr> </tbody> </table> <p>The extent of weed growth (height or width) shall not compromise road corridor asset integrity or full and safe use (even if individual weed heights and widths are smaller than the maximum heights and widths in Table 1).</p> <p>There shall not be a continuous carpet of weeds (irrespective of individual weed size) on loose metal shoulders, or traffic islands, or in large cracks in kerbs or road corridor surfaces.</p> <p>There shall also be no cut edge material present.</p> <p>Weed treatment shall not damage tree bark or exposed roots or result in tree damage from basal uptake of agrichemicals or organic herbicides by feeding roots.</p> <p>An audit tolerance will be applied to quality auditing to make allowance for minor and non-material service delivery 'misses' in accordance with the criteria specified in Table 1.</p>	Level of Service	High Profile	Medium Profile	Low Profile	Work Treatment	Agrichemical (Glyphosate); Organic Herbicide, Organic Herbicide + Agrichemical (Glyphosate), Thermal, Innovation			Weed Management – Road Corridor (including Tree circles on non-maintained berms)				Maximum weed Height OR Width	50mm	100mm	125mm	Audit Tolerance Minor and non-material missed weed treatment in Road Corridor	<ul style="list-style-type: none"> ✓ Permitted - Minor miss of standalone weeds (<5 weeds per 100 linear metres). * Not Permitted - Patches comprised of multiple weeds. * Not Permitted - Repeated pattern of missed standalone weeds. 			Audit Tolerance Number of linear metres of continuous carpet of weeds of any dimension per 100 linear metres of road corridor.	<ul style="list-style-type: none"> ✓ Permitted - Minor miss of continuous weed carpet (<5 linear metre continuous carpet per 100 metres). ✓ Permitted – Minor miss of continuous weed carpet (<1 linear metre on a traffic island, or in a crack in road or kerb surface). * Not Permitted - Repeated pattern of continuous weed carpet. 			<p>Weeds</p> <ul style="list-style-type: none"> • Weeds (<) less than maximum height and or width for level of service (factoring audit tolerance). • Weeds do not compromise full and safe use and asset integrity of the road corridor and associated assets. • Continuous carpet of weeds of any dimension (factoring audit tolerance) does not compromise visual amenity, full and safe use and asset integrity of the road corridor and associated assets. • No cut weed material present. • No tree damage from tree circle weeds treatment.
Level of Service	High Profile	Medium Profile	Low Profile																									
Work Treatment	Agrichemical (Glyphosate); Organic Herbicide, Organic Herbicide + Agrichemical (Glyphosate), Thermal, Innovation																											
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C – Urban Streetscape Edging & Weed Management – Outcome Technical Specification

Clause	Clause Component	Extent of Works	Specification	Technical Outcome(s)																												
C2 Weeds and Edging	C2.2 Edge Management Targets (Road Corridor)	All Road Corridor Asset and Locations	<p>Edges</p> <p>The Supplier shall manage edges in accordance the Road Corridor at heights, widths, or horizontal encroachment widths less than the maximum:</p> <ol style="list-style-type: none"> height or width or asset edge horizontal encroachment width in Table 2 (below). <p><i>Table 2 – Maximum Edging Clearance Targets – Road Corridor</i></p> <table border="1"> <thead> <tr> <th>Level of Service</th> <th>High Profile</th> <th>Medium Profile</th> <th>Low Profile</th> </tr> </thead> <tbody> <tr> <td>Work Treatment</td> <td colspan="3">Agrichemical (Glyphosate); Organic Herbicide, Organic Herbicide + Agrichemical (Glyphosate), Thermal, Innovation</td> </tr> <tr> <td colspan="4">Edging – Road Corridor (including Tree circles on non-maintained berms)</td> </tr> <tr> <td>Maximum horizontal encroachment over the asset edge</td> <td>20mm</td> <td>50mm</td> <td>100mm</td> </tr> <tr> <td>Maximum vertical edge height</td> <td>20mm</td> <td>50mm</td> <td>100mm</td> </tr> <tr> <td>Maximum treated edge width</td> <td><50mm</td> <td><100mm</td> <td><125mm</td> </tr> <tr> <td>Audit Tolerance Minor and non-material missed edge treatment in Road Corridor</td> <td colspan="3"> <ul style="list-style-type: none"> ✓ Permitted - Minor miss of standalone edge sections (<1m long). × Not Permitted - Repeated pattern of missed edges. × Not Permitted - Treated edge width > maximum target width . </td> </tr> </tbody> </table> <p>Treated edges within the Road Corridor shall not be taller or wider or have horizontal encroachment widths wider than the maximum heights or widths or asset edge encroachment widths in Table 2.</p> <p>The extent of edge growth (height, width, or encroachment) shall not compromise road corridor asset integrity or full and safe use (even if edge heights and widths are less than the maximum heights and widths in Table 2).</p> <p>There shall also be no cut edge material present.</p> <p>Maximum tree circle diameter (<) less than 700mm. Weed treatment shall not damage tree bark or exposed roots or result in tree damage from basal uptake of agrichemicals or organic herbicides by feeding roots.</p> <p>An audit tolerance will be applied to quality auditing to make allowance for minor and non-material service delivery 'misses' in accordance with the criteria specified in Table 2.</p>	Level of Service	High Profile	Medium Profile	Low Profile	Work Treatment	Agrichemical (Glyphosate); Organic Herbicide, Organic Herbicide + Agrichemical (Glyphosate), Thermal, Innovation			Edging – Road Corridor (including Tree circles on non-maintained berms)				Maximum horizontal encroachment over the asset edge	20mm	50mm	100mm	Maximum vertical edge height	20mm	50mm	100mm	Maximum treated edge width	<50mm	<100mm	<125mm	Audit Tolerance Minor and non-material missed edge treatment in Road Corridor	<ul style="list-style-type: none"> ✓ Permitted - Minor miss of standalone edge sections (<1m long). × Not Permitted - Repeated pattern of missed edges. × Not Permitted - Treated edge width > maximum target width . 			<p>Edges</p> <ul style="list-style-type: none"> • Edges (<) less than maximum height or horizontal encroachment width for level of service (factoring audit tolerance). • Treated edges no wider than maximum specified width. • Edges do not compromise full and safe use and integrity of the road corridor and associated assets. • No cut edge material present. • Maximum tree circle diameter (<) less than 700mm. • No tree damage from tree circle edge treatment.
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C – Urban Streetscape Edging & Weed Management – Outcome Technical Specification

Clause	Clause Component	Extent of Works	Specification	Technical Outcome(s)												
C2 Weeds and Edging	C2.3 Weed Management Targets (Town Centre (A))	All Town Centre (A) Assets and Locations	<p>The Supplier shall maintain Town Centre (A) locations 'weed-free'.</p> <p><i>Table 3 – Maximum Weed Management Clearance Targets – Town Centre (A)</i></p> <table border="1"> <thead> <tr> <th>Level of Service</th> <th>All</th> </tr> </thead> <tbody> <tr> <td>Work Treatment</td> <td>Agrichemical (Glyphosate); Organic Herbicide, Organic Herbicide + Agrichemical (Glyphosate), Thermal, Mechanical, Innovation (Low Carbon)</td> </tr> <tr> <td colspan="2">Weed Management – Town Centre (A) (including Tree circles)</td> </tr> <tr> <td>Audit Tolerance No of breaches of individual or weed height or width per 100 square metres of Town Centre (A).</td> <td> <ul style="list-style-type: none"> ✓ Permitted - Minor miss of standalone weeds (<20mm wide or high; <5 weeds per 100m²). × Not Permitted - Patches comprised of multiple weeds × Not Permitted - Repeated pattern of missed standalone weeds </td> </tr> </tbody> </table> <p>Weed treatment shall not damage tree bark or exposed roots or result in tree damage from basal uptake of agrichemicals or organic herbicides by feeding roots.</p> <p>There shall be no cut weed material present.</p> <p>An audit tolerance will be applied to quality auditing to make allowance for minor and non-material service delivery 'misses' in accordance with the criteria specified in Table 3.</p>	Level of Service	All	Work Treatment	Agrichemical (Glyphosate); Organic Herbicide, Organic Herbicide + Agrichemical (Glyphosate), Thermal, Mechanical, Innovation (Low Carbon)	Weed Management – Town Centre (A) (including Tree circles)		Audit Tolerance No of breaches of individual or weed height or width per 100 square metres of Town Centre (A).	<ul style="list-style-type: none"> ✓ Permitted - Minor miss of standalone weeds (<20mm wide or high; <5 weeds per 100m²). × Not Permitted - Patches comprised of multiple weeds × Not Permitted - Repeated pattern of missed standalone weeds 	<p>Weeds</p> <ul style="list-style-type: none"> • No weeds present (factoring audit tolerance). • No tree damage from tree circle weeds treatment. • No cut weed material present. 				
	Level of Service		All													
Work Treatment	Agrichemical (Glyphosate); Organic Herbicide, Organic Herbicide + Agrichemical (Glyphosate), Thermal, Mechanical, Innovation (Low Carbon)															
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C2.4 Edging Targets (Town Centre (A))	<p>Edges</p> <p>The Supplier shall manage edges within Town Centre (A) at heights, widths, or horizontal encroachment widths less than the maximum:</p> <ol style="list-style-type: none"> a) height or b) width or c) horizontal edge encroachment width in Table 4 (below). <p><i>Table 4 – Maximum Edging Clearance Targets – Town Centre (A)</i></p> <table border="1"> <thead> <tr> <th>Level of Service</th> <th>All</th> </tr> </thead> <tbody> <tr> <td>Work Treatment</td> <td>Agrichemical (Glyphosate); Organic Herbicide, Organic Herbicide + Agrichemical (Glyphosate), Thermal, Mechanical, Innovation (Low Carbon)</td> </tr> <tr> <td colspan="2">Weed Management – Town Centre (A) (including Tree circles)</td> </tr> <tr> <td>Maximum horizontal encroachment over the asset edge</td> <td>20mm</td> </tr> <tr> <td>Maximum vertical edge height</td> <td>20mm</td> </tr> <tr> <td>Maximum treated edge width</td> <td>20mm</td> </tr> <tr> <td>Audit Tolerance No of discrete breaches of individual edge height or width or horizontal asset encroachment width per 100 square metres of Town Centre (A).</td> <td> <ul style="list-style-type: none"> ✓ Permitted – Minor miss of standalone edge sections (<1m long per 100m²) × Not Permitted - Repeated incidences of missed edges. × Not Permitted - Treated edge width > maximum target width </td> </tr> </tbody> </table> <p>Maximum tree circle diameter (<) less than 700mm. Weed treatment shall not damage tree bark or exposed roots or result in tree damage from basal uptake of agrichemicals or organic herbicides by feeding roots.</p> <p>There shall be no cut edge material present.</p> <p>An audit tolerance will be applied to quality auditing to make allowance for minor and non-material service delivery 'misses' in accordance with the criteria specified in Table 4.</p>	Level of Service	All	Work Treatment	Agrichemical (Glyphosate); Organic Herbicide, Organic Herbicide + Agrichemical (Glyphosate), Thermal, Mechanical, Innovation (Low Carbon)	Weed Management – Town Centre (A) (including Tree circles)		Maximum horizontal encroachment over the asset edge	20mm	Maximum vertical edge height	20mm	Maximum treated edge width	20mm	Audit Tolerance No of discrete breaches of individual edge height or width or horizontal asset encroachment width per 100 square metres of Town Centre (A).	<ul style="list-style-type: none"> ✓ Permitted – Minor miss of standalone edge sections (<1m long per 100m²) × Not Permitted - Repeated incidences of missed edges. × Not Permitted - Treated edge width > maximum target width 	<p>Edges</p> <ul style="list-style-type: none"> • Edges (<) less than maximum height or horizontal encroachment width for level of service (factoring audit tolerance) • Treated edges no wider than maximum specified width. • Maximum tree circle diameter (<) less than 700mm. • No tree damage from tree circle edge treatment. • No cut edge material present.
Level of Service	All															
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C – Urban Streetscape Edging & Weed Management – Outcome Technical Specification

Clause	Clause Component	Extent of Works	Specification	Technical Outcome(s)
C3 Agrichemicals & Organic Herbicides	C3.1 Compliance	All Scheduled Locations & Assets	<p>Compliance</p> <p>The Supplier shall comply with best practice industry standards, legislative requirements and Auckland Council Plans and Policies related to the use of Agrichemicals.</p> <p>Industry Standards</p> <ul style="list-style-type: none"> NZS 8409 Management of Agrichemicals <p>Policies and Plans</p> <ul style="list-style-type: none"> Operative Auckland Unitary Plan Operative Auckland Air, Land and Water Plan <p>Legislative requirements include:</p> <ul style="list-style-type: none"> Hazardous Substances and New Organisms Act 1996 Resource Management Act (RMA) 1991 Health and Safety at Work Act 2016 and associated regulations <p>Auckland Council Plans and Policies include:</p> <ul style="list-style-type: none"> Regional Pest Management Plan (RPMP) – Mahere Whakahaere Kīrearea ā-Rohe (www.aucklandcouncil.govt.nz/plans-projects-policies-reports-bylaws/our-plans-strategies/topic-based-plans-strategies/environmental-plans-strategies/Pages/regional-pest-management-plan.aspx) Auckland Council Weed Management Policy – Kaupapa Here Ngaki Tarutaru (www.aucklandcouncil.govt.nz/plans-projects-policies-reports-bylaws/our-policies/Pages/weed-management-policy.aspx) Kauri Die back Standard Operating Procedure (SOP). <p>The Principal will notify the Supplier of any changes in such policies and procedures and the Supplier shall immediately comply with all such changes.</p>	<p>Compliance</p> <ul style="list-style-type: none"> Supplier fully complies with best practice industry standards, legislative requirements and Auckland Council Plans and Policies when delivering contract services.
	C3.2 Use of Agrichemicals & Organic Herbicides		<p>C3.2.1 Management & Applicator Qualifications</p> <p>For Supplier personnel managing the application of agrichemicals, the minimum qualification shall be Registered Chemical Applicator (RCA) to:</p> <ul style="list-style-type: none"> Implement and monitor spray plans Provide direction to staff applying agrichemicals Make day-to-day decisions in relation to agrichemical application Apply agrichemicals in a safe, responsible, and effective way with minimal adverse impact on human and environmental health. Meet legislative and Council obligations. <p>For Supplier personnel applying agrichemicals under direct supervision of a RCA, the minimum qualification shall be Growsafe (basic) and for applicators not under the direct supervision of a RCA, the minimum qualification shall be Growsafe (standard).</p> <p>The Supplier shall provide a list of all persons who are qualified to undertake spraying at the commencement of the Agreement period and provide an updated list following any staff changes. The Principal may request copies of certificates of registration for inspection at any time.</p>	<p>Management & Applicator Qualifications</p> <ul style="list-style-type: none"> Supplier Personnel qualified to manage and implement agrichemical and organic herbicide programmes. Supplier personnel lists and qualifications provided at contract commencement and updated annually.

C – Urban Streetscape Edging & Weed Management – Outcome Technical Specification

Clause	Clause Component	Extent of Works	Specification	Technical Outcome(s)
C3 Agrichemicals & Organic Herbicides	C3.2 Use of Agrichemicals & Organic Herbicides	All Scheduled Locations & Assets	<p>C3.2.2 Product and Application Records and Reporting</p> <p>The Supplier shall provide and maintain a register of Agrichemical and Organic Herbicide products used for contract operations.</p> <p>The Supplier shall maintain spray records (format and content shall approved by the Principal) for all Agrichemical and Organic Herbicide applications.</p> <p>The Supplier shall record and report all usage of agrichemicals and organic herbicides to the Principal in accordance with Schedule 9.</p> <p>C3.2.3 Storage & Handling</p> <p>Agrichemicals and Organic Herbicides shall be stored and handled in accordance with good management practices, as described in New Zealand Standard 8409: 2004 Management of Agrichemicals so there is no contamination of land, groundwater, surface waters and non-target areas.</p> <p>C3.2.4 Programme Delivery</p> <p>The Supplier shall deliver services in accordance with General Specification – Clause 6 – Working Hours. Programme delivery shall consider factors including, but not limited to, public use, weather conditions, traffic management and public safety.</p> <p>Application of agrichemicals and organic herbicides shall be informed by the Manufacturers' recommendations.</p> <p>The Supplier shall undertake spraying of agrichemicals and organic herbicides with care and accuracy.</p> <p>No spray marker dye shall be used unless instructed by the Principal (due to consequential public enquiries and potential environmental impact).</p> <p>The Supplier shall ensure work is carried out using a methodology that prevents any spray drift, transfer or leaching onto adjacent property or non-target species or non-target areas.</p> <p>No Agrichemical or Organic Herbicide sprays shall contact non-target trees or vegetation or surfaces which may be damaged by spraying including, but not limited to, turf, tree trunks, basal growth or active growth nodes, surface root plates, or any other living tree part, plants in gardens, or any other vegetation that is not a weed.</p> <p>The Supplier shall ensure Agrichemical and Organic Herbicide applications do not cause spillage, leaching, runoff, contamination or pollution of adjacent property, water courses or drainage systems.</p> <p>C3.2.5 Plant & Equipment</p> <p>All plant and equipment used in the application of Agrichemicals and Organic Herbicides shall be properly maintained and fitted with an effective anti-drift guard such as a 'spray cone shield' or a 'drift guard' or equivalent to prevent spray drift onto neighbouring areas or plants, a pressure-regulating device, and a spray nozzle that minimises spray drift.</p> <p>All plant and equipment used to apply Agrichemicals and Organic Herbicides shall meet New Zealand Standards regarding maximum operating noise levels and the Health and Safety at Work Act 2016.</p> <p>Where spraying is being undertaken alongside roads, vehicles associated with the spraying shall display prominent signs on both the front and back of the vehicle, advising that spraying is in progress. Where spraying is undertaken at a location (e.g., Town Centre), signs shall be placed at key entry and/or exit points prior to, during and after commencement of treatments to inform the public that spraying is in progress.</p> <p>The Supplier must ensure all operators are provided with at least the minimum level of safety equipment required.</p>	<p>Product & Application Records and Reporting</p> <ul style="list-style-type: none"> Register of Agrichemical and Organic Herbicide maintained and reported. <p>Storage and Handling</p> <ul style="list-style-type: none"> Agrichemical and Organic Herbicide products stored and handled in accordance with New Zealand Standard 8409: 2004 Management of Agrichemicals. <p>Programme Delivery & Plant and Equipment</p> <ul style="list-style-type: none"> The Supplier factors in and manages all delivery variables during implementation of a works programme to fully deliver technical and contract outcomes. The Supplier's methodology (including plant and equipment) facilitates delivery of the work programme safely and without excessive noise or damage to assets.

C – Urban Streetscape Edging & Weed Management – Outcome Technical Specification

Clause	Clause Component	Extent of Works	Specification	Technical Outcome(s)
C3 Agrichemicals & Organic Herbicides	C3.2 Use of Agrichemicals & Organic Herbicides	All Scheduled Locations & Assets	<p>C3.2.6 Difficult-to-control Weeds</p> <p>The Supplier shall notify the Principal of locations where weeds (e.g., nutgrass) are unable to be successfully managed using glyphosate or organic herbicide. The Supplier shall present the Principal with an ‘alternate control methodology’ proposal including, but not limited to:</p> <ul style="list-style-type: none"> • Weed species • Location(s) and level of infestation (area of town centre or length of road corridor). • Alternate product, methodology and programme <p>An alternate product or methodology shall be approved by the Principal.</p> <p>The Supplier shall notify the Principal prior to commencement of auditing of the affected site(s) for any auditing dispensation to be considered. Dispensation shall be provided at the discretion of the Principal.</p> <p>C3.2.7 Rectification of Damage</p> <p>It shall be the sole responsibility of the Supplier to ‘make good’ any non-target vegetation damage, road corridor or town centre asset damage or pollution or contamination resulting from treatment operations at their own cost. Damage shall be reinstated or repaired so that the asset condition is returned to a standard at least equivalent to the original condition. The Supplier will be held responsible for any claims or compensation arising from his/her actions or omission in accordance with General Terms clause 11.2 – Defective Services.</p> <p>Any area of ‘over-spray’ from urban road edge or verge that exceeds the maximum specified clearance distances will be deemed to be damaged and shall be reinstated at the Supplier’s expense (Schedule 1a – General Specification (clause 12).</p> <p>The Supplier shall notify the Principal of locations, areas or assets that have been historically ‘over sprayed’ and work with the Principal to stop further damage.</p>	<p>Difficult to Control Weeds</p> <ul style="list-style-type: none"> • The Supplier uses a methodology that is approved by the Principal to manage ‘difficult to control’ weeds on a case-by-case basis. <p>Rectification of Damage</p> <ul style="list-style-type: none"> • The Supplier repairs or reinstates damage or replaces assets damaged during delivery of contract services.
C4 ‘No Spray’ Register & Public Notification	C4.1 ‘No Spray’ Register	All ‘No spray’ locations	<p>‘No Spray’ Register</p> <p>The Supplier will be responsible for implementing the No Spray Register maintained and updated by Council. The ‘No Spray’ Register includes, but is not limited to, locations where private or commercial property owners or occupiers have requested that no Agrichemicals be used on road frontages bordering the property boundary. The register may also include ‘No Spray’ frontages for parks, reserves, or road reserves where weed management is not be undertaken using Agrichemicals.</p> <p>There shall be no spraying of any location included in the ‘No Spray Register’. Non-compliance may result in reinstatement of damage and/or application of costs to the affected parties in accordance with General Specifications - Clause 12 - Asset Care, Damage Reinstatement.</p> <p>Public Notification</p> <p>The Supplier (at its own cost) shall notify adjoining properties at ‘no spray’ boundaries on the ‘no spray’ register that a spray plan has been developed (and is available on request) at least two days’ notice prior to application. Notification shall be in writing by way of:</p> <ul style="list-style-type: none"> • publication in the relevant local newspaper, or • other approved methodology e.g., information or letterbox drops. <p>The format and content of public notices shall be in accordance with Auckland Transport policy and guidelines and shall include, but is not limited to:</p> <ul style="list-style-type: none"> ✓ Supplier’s name ✓ Details of the spray locations ✓ Proposed period of spraying ✓ Agri-chemical product ✓ Notice that private berms will not be sprayed. <p>The notice shall be published 6 weeks prior to spraying.</p>	<p>‘No Spray’ Register</p> <ul style="list-style-type: none"> • No spraying of any location in the ‘No Spray Register’. • Public notified of spraying using an approved public notice, approved guidelines, and specified timeframes. • The Supplier repairs or reinstates damage or replaces assets damaged during spraying of locations included in the ‘No Spray Register’.

C – Urban Streetscape Edging & Weed Management – Outcome Technical Specification

Technical Specification Clause	Clause No	Extent of Works	Specification	Technical Outcome(s)
C5 Weed Control Treatments	C5.1 – Glyphosate	All Scheduled Locations & Assets	<p>C5.1.1 Glyphosate Product</p> <p>The following glyphosate products have been assessed by Auckland Council and approved for use by Suppliers:</p> <ul style="list-style-type: none"> • Agpro Green Glyphosate 510 • Agpro Glyphosate Gel 120 • Ravensdown Glyphosate G360 • Ravensdown Glyphosate 540 <p>Auckland Council may assess the formulation of the glyphosate products used in its contracts and advise whether the products are still safe to use. If the Supplier proposes to use an alternate glyphosate product, it must be reviewed by Council and approved by Auckland Transport and the Principal prior to use.</p> <p>Glyphosate products shall not contain the surfactant polyoxyethylene tallow amine (POEA) due to the potential for transport into surface water and groundwater.</p> <p>C5.1.2 Glyphosate Application</p> <p>Glyphosate shall be applied in accordance with technical specifications clauses C1 – C4.</p> <p>The Supplier shall use a methodology and spray programme that facilitates control of weeds in accordance with the clearance targets in technical specifications clauses C1 and C2.</p> <p>Where glyphosate is specified as part of a combined Organic Herbicide+ Agrichemical treatment option (Schedule 3 - Work Programme), glyphosate shall be applied no more than three times annually. Application periods shall be restricted to spring (Sep-Nov) and autumn (Mar-Apr) to assist management of 'growth flush' periods.</p> <p>C5.1.3 Glyphosate Efficacy</p> <p>There shall be evidence of weed 'die back' within 14 calendar days of spraying and 100% weed or edge control within 31 calendar days of treatment. This 'die back' period will be used to inform the timing of auditing and effectiveness of the work treatment.</p>	<p>Glyphosate</p> <ul style="list-style-type: none"> • The Supplier uses an approved product in accordance with clauses C1 – C4. • The Supplier methodology results in effective weed and edge control. • When glyphosate is part of a combination Organic Herbicide + Agrichemical (glyphosate) treatment, it is not be applied more than 3 times annually and only in the periods Sep – Nov and Mar – Apr. • Auditing is informed by a 14-calendar day 'die back' evidence period and a 31-calendar day control period.
	C5.2 – Organic Herbicide	All Scheduled Locations & Assets	<p>C5.2.1 Organic Herbicide Product</p> <p>Organic Herbicide products shall be a 'plant-derived' oil-based, acetic acid based or fatty acid-based weed control product with an emulsifier and must be reviewed by Council and approved by Auckland Transport and the Principal prior to use.</p> <p>C5.2.2 Organic Herbicide Application</p> <p>Approved Organic Herbicides shall be applied in accordance with clauses C1 – C4.</p> <p>The Supplier shall use a methodology and spray programme that facilitates control of weeds in accordance with the clearance targets in technical specifications clauses C1 and C2.</p> <p>C5.2.3 Organic Herbicide Efficacy</p> <p>There shall be evidence of weed 'die back' within 7 calendar days of spraying and 100% weed or edge control within 31 calendar days of treatment. This 'die back' period will be used to inform the timing of auditing and effectiveness of the work treatment.</p>	<p>Organic Herbicide</p> <ul style="list-style-type: none"> • The Supplier uses an approved product in accordance with clauses C1 – C4. • The Supplier methodology results in effective weed and edge control. • Auditing is informed by a 7-calendar day 'die back' evidence period and a 31-calendar day control period.

C – Urban Streetscape Edging & Weed Management – Outcome Technical Specification

Technical Specification Clause	Clause No	Extent of Works	Specification	Technical Outcome(s)
C5 Weed Control Treatments	C5.3 – Thermal (Hot Water/Steam)	All Scheduled Locations & Assets	<p>C5.3.1 Thermal Methodology</p> <p>The thermal methodology may be either steam or hot water. If an insulating foam is used as part of the methodology, the foam product shall be approved by the Principal and foam volumes recorded and reported monthly.</p> <p>The control system shall consider delivery of a minimum temperature of 100°C at the weed control point for a sufficient period to cause intracellular water expansion and cell membrane rupture.</p> <p>The treatment methodology shall not result in contamination of the downstream road corridor or town centre environment (e.g., runoff into storm water system).</p> <p>Care shall be taken when moving hoses and associated equipment across pedestrian areas and that appropriate signage shall be placed to eliminate tripping hazards.</p> <p>When refilling water tanks from a hydrant, filling equipment including standpipe, back flow preventer and meter shall be provided by the Supplier. The Supplier shall record and report all water volumes monthly in accordance with Schedule 9 Reporting requirements.</p> <p>C5.3.1 Thermal Efficacy</p> <p>There shall be evidence of weed ‘die back’ within 2 calendar days of treatment and 100% weed or edge control shall be achieved within 14 calendar days of treatment. This ‘die back’ period will be used to inform the timing of auditing.</p>	<p>Thermal (Hot Water/ Steam)</p> <ul style="list-style-type: none"> The Supplier methodology results in effective weed and edge control. If the Supplier methodology uses an approved foam insulating product it is approved by the Principal. The minimum temperature at point of discharge is 100°C. Foam volumes are recorded and reported monthly. Water volumes are recorded and reported monthly. Auditing is informed by a 2-calendar day ‘die back’ evidence period and a 14-calendar day control period.
	C5.4 – Mechanical (including Edging)		<p>All weeds shall be mechanically removed using a mechanical methodology such as weed eaters/line trimmer (or similar plant and equipment), ‘grubbing out’ or chipping out weeds mechanically, or by hand removal. Where practicable, the methodology shall support removal of the complete weed root system.</p> <p>Any weed trimmings created shall be collected by sweeping or blowing, picked up and disposed off-site to an approved green waste management facility. Under no circumstances shall the Supplier temporarily stockpile weed material on site.</p> <p>The Supplier shall carry out good weed hygiene practice, ensuring that work activities do not result in the transfer or spreading of any weeds.</p> <p>Mechanical edging is not specified as a standalone treatment in Road Corridors but shall be used alongside other treatments to support delivery of contract specifications and outcomes.</p>	<p>Mechanical</p> <ul style="list-style-type: none"> The Supplier methodology results in effective weed and edge control. No weed or edge debris left on site. No transfer of weeds between sites.
	C5.5 – Innovation (Low Carbon)		<p>C5.3.1 Innovation (Low Carbon) Methodology</p> <p>The Innovation (Low Carbon) methodology shall not use Agrichemicals or Organic Herbicides</p> <p>The Innovation (Low carbon) methodology shall have carbon emissions that are >50% lower than other specified treatments. Carbon emissions shall be measured and benchmarked in year 1 in accordance with Schedule 10 (clause 4.10)</p> <p>The methodology shall be agreed with and approved by the Principal.</p> <p>C5.5.1 Innovation Efficacy</p> <p>The ‘evidence of die back’ and 100% control periods shall be agreed with and approved by the Principal. This ‘die back’ period will be used to inform the timing of auditing and effectiveness of the work treatment.</p>	<p>Innovation (Low Carbon)</p> <ul style="list-style-type: none"> The Supplier methodology results in effective weed and edge control. Auditing is informed by an agreed ‘die back’ evidence period and an agreed control period.

SCHEDULE 1c – PERFORMANCE TECHNICAL SPECIFICATION

Urban Streetscape Edging & Weed Management

Town Centres (B,C)

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A DEFINITIONS

Item	Definition
Agrichemical	Agrichemicals are chemical products used in agriculture including herbicides.
Boundary	A line which marks the limits of an area.
Carriageway	'The Carriageway' is defined as the road surface from the edge of the channel to the centre line.
Channel	'Channel' is defined as the surface water drain extending from a hard surface or natural edge.
Cycleway	'Cycleway' is defined as a hard surface which is legally designated for dedicated cycling or is a shared path for cyclists and pedestrians (generally identifiable through traffic control measures such as, but not limited to, signage or road markings) as informed by the asset data.
Edging	Control of grass and weeds encroaching onto a hard surface or asset either horizontally or vertically, carried out as per the specifications
Footpath	'Footpath' is defined as any walkway, service lane or shared space.
Hard Surfaces	'Hard Surfaces' are defined as surfaces that include but are not limited to cycleways, special vehicle lanes, footpaths, paved areas, tracks and other paths, business frontages, entrances to the front door of a business, on-road car parks, off road carparks, median strips, catch-pit grates, backing plates, traffic islands, speed humps, speed tables, kerbing, bridged channels, roundabouts, shared spaces, and kerb and channels including the road carriageway.
Herbicide	A product used to destroy or inhibit plant growth of weeds.
No Spray Register	Register containing the names and addresses of property owners or residents who have requested that Agrichemicals are not used on the road frontage of the road corridor and also require notification prior to spraying operations being undertaken in proximity of the property
Organic Herbicide	A 'plant-derived' oil-based, acetic acid based or fatty acid-based weed control product.
Response Work	'Response work' (Schedule 3) refers to reactive response work (RFS) generated by customers, Auckland Council, or the Supplier.
Road Corridor	The 'Road Corridor' has the same meaning as road in the Local Government Act 1974 (Section 315) and is defined as the complete area from boundary to boundary including the boundary itself. It encompasses the carriageway (formed road), road surface, kerb and channelling, city and town centres, berms, shoulders, footpaths, cycleways, cycle paths, traffic islands, surface water drains, pleasure areas, bridal paths, land that is legally designated as road but is not currently formed as carriageway or footpath (legal road, unformed road, or paper road), street to street walkways and carparks.
Shared Space	'Shared Space' is where the traditional distinction between footpath and road has been removed so that vehicles, pedestrians, and cyclists can share the space (the space is maintained to footpath specification).
Shoulder	'Shoulder' is defined as the gravel area on the side of the carriageway which is normally from the carriageway to the bottom of the swale drain. In the urban areas these are typically located in the transition area from rural to urban zones and along carriageways without a formed kerb.
Spraying	Control of weeds by use of liquid products including Agrichemicals and Organic Herbicides.
Street Furniture	'Street Furniture' is defined as any asset fixed within the road corridor such as but not limited to a bus shelter, litter and recycling street bins, seats, parking meters, bollards, sight rails, railings, fences, handrails, in-ground lights, cycle - rails stands and racks, pedestrian safety fences and crossing barriers, structures, glass panels, traffic aids or structures including, service lanes or shared spaces, any concrete pads and foundations for furniture items if present.
Street Tree	Tree located within the road corridor, on the grass verge or berm, or occasionally within the paved part of public roads, shared or civic spaces.
Weed	'Weed' is defined by the Auckland Council Weed Management Policy as any plant or part of a plant growing where it is not wanted and which may have an adverse effect on people, Māori cultural values, infrastructure, other built assets, or the natural environment. Weeds include, but are not limited to, pest plants identified in the Auckland Regional Pest Management Strategy (RPMS).
Weed Management	'Weed management' is the control of weeds in the road corridor in accordance with the technical specifications.

B – Contract Outcomes, Technical KPIs & Contract Management KPIs

B1.1 Contract Outcomes

Contract Outcomes
1. Road corridors are safe and aesthetically pleasing and asset life is not compromised by weed management.
2. Weeds do not damage road surfaces or road assets.
3. Weeds do not impede the flow of drainage water.
4. Town centres are tidy, well-maintained, and aesthetically pleasing.
5. Industry standards, legislative requirements and Auckland Council Plans and Policies are adhered to.
6. Agreed sustainability and environmental innovation targets are implemented.
7. Supplier adopts and implements environmentally sustainable treatment methodologies (where practicable and without compromising methodology effectiveness).

B1.2 Technical KPIs

KPI No	Technical KPI	Agrichemical	Organic Herbicide	Mechanical	Thermal	Low Carbon
B1.2.1	• All weeds across full extent of Town Centre (B,C) treated (evidence of weed treatment within specified treatment 'die back' timeframes).	✓	✓	✓	✓	✓
B1.2.2	• All edges across full extent of Town Centre (B,C) treated (evidence of edge treatment within specified treatment 'die back' timeframes).	✓	✓	✓	✓	✓
B1.2.3	• No weeds or edges taller than 200mm.	✓	✓		✓	✓
B1.2.4	• 100% control of weeds achieved within specified treatment control period timeframes.	✓	✓	✓	✓	✓
B1.2.5	• 100% control of edges achieved within specified treatment control period timeframes.	✓	✓	✓	✓	✓
B1.2.6	• No unapproved Agrichemicals or Organic Herbicide products or surfactants/wetting agents used.	✓	✓		✓	✓
B1.2.7	• No spray dye marker used.	✓	✓	✓	✓	✓
B1.2.8	• No non-target vegetation asset damage or infrastructure asset damage.	✓	✓	✓	✓	✓
B1.2.9	• No locations or assets on the 'no spray register sprayed'.	✓	✓			
B1.2.10	• No cut weed debris left on site.	✓	✓	✓	✓	✓

B1.3 Contract Management KPIs

KPI No	Technical KPI
B1.3.1	<ul style="list-style-type: none"> Supplier personnel applying Agrichemicals and Organic Herbicides are qualified.
B1.3.2	<ul style="list-style-type: none"> Agrichemicals and Organic Herbicides stored and handled in accordance with good management practices.
B1.3.3	<ul style="list-style-type: none"> Timing of weed management and edging treatments in accordance with restrictions for educational, day-care and community facilities, and outside peak use periods for shops, bus stops, walking school bus and main arterial routes.
B1.3.4	<ul style="list-style-type: none"> Plant and equipment and methodology used in the application of Agrichemicals and Organic Herbicides effectively manage risk of spray drift and soil, groundwater, or surface water contamination.
B1.3.5	<ul style="list-style-type: none"> Agrichemicals and Organic herbicides applied in strict accordance with the Manufacturers' recommendations.
B1.3.6	<ul style="list-style-type: none"> Asset damage fully reinstated or repaired at Supplier's cost to at least original condition.
B1.3.7	<ul style="list-style-type: none"> No Spray Register adhered to and public notification of properties on 'No Spray' Register completed in accordance with notification timeframes.
B1.3.8	<ul style="list-style-type: none"> Glyphosate used a maximum of 3x annually, and in the specified months for combined (Organic Herbicide + Agrichemical (glyphosate) treatments).
B1.3.9	<ul style="list-style-type: none"> No validated contamination of storm water network resulting from contract operations.
B1.3.10	<ul style="list-style-type: none"> Thermal methodology delivers steam or hot water at minimum 100°C at point of control.

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C – Urban Streetscape Edging & Weed Management – Performance Technical Specification

Clause	Clause Component	Extent of Works	Specification	Post-Treatment Technical KPI(s)
C1 Extent of Works	C1.1 – Extent of Works	All Scheduled Town Centre (B,C) Locations & Assets	<p>Weed management and edging shall include all weeds appearing in or on hard surfaces or encroaching over surfaces or edges or assets (e.g., street furniture) in the road corridor or town centre from boundary to boundary (including the boundaries). The extent of works shall include all sealed, concrete, or unsealed areas including, but is not limited to:</p> <ul style="list-style-type: none"> • road carriageway surface • bridge decks • shoulders • structure foundations • catchpits, drains, manholes • culverts & open drains • pavement edges • kerb and channel • footpaths, walkways and accessways • service lanes • carparks • cycle lanes and cycle paths • expansion and construction joints • Street Furniture (e.g., lighting poles, power and telephone poles, telecommunication pillars, service boxes, utility cabinets; and other fixings regarded as street furniture) • traffic signs and edge marker posts • tree circles. <p>The Supplier shall not complete weed management and edging of berms maintained by private property owners or occupiers provided these areas are in alignment with the technical specification clearance targets and outcomes.</p>	<p>Extent of Works</p> <ul style="list-style-type: none"> • The full extent of contract locations and assets maintained. • Weed control and edging not undertaken on road corridor berms maintained by property owners or occupiers (where these areas are in alignment with the technical specification clearance targets and outcomes).

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C – Urban Streetscape Edging & Weed Management – Performance Technical Specification

Clause	Clause Component	Extent of Works	Specification	Post-Treatment Technical KPI(s)																		
C2 Weeds and Edging	C2.1 Weed Management Targets (Town Centre (B,C))	All Scheduled Town Centre (B,C) Locations & Assets	<p>Weeds</p> <p>The Supplier shall treat all weeds within Town Centre (B,C) - Road corridor, Plazas, and Carparks - at each scheduled visit. There shall be no weeds (treated or untreated) taller or wider than 200mm (to inform a potential missed treatment).</p> <p><i>Table 1 – Maximum Weed Management Clearance Targets – Town Centre (B,C)</i></p> <table border="1"> <thead> <tr> <th>Level of Service</th> <th>High Profile</th> <th>Medium Profile</th> <th>Low Profile</th> </tr> </thead> <tbody> <tr> <td>Work Treatment</td> <td colspan="3">Agrichemical (Glyphosate); Organic Herbicide, Organic Herbicide + Agrichemical (Glyphosate), Thermal, Mechanical, Innovation (Low Carbon)</td> </tr> <tr> <td colspan="4">Weed Management – Town Centre (B,C) (including Tree Circles)</td> </tr> <tr> <td>Audit Tolerance Minor and non-material missed weed treatment Town Centre (B,C).</td> <td colspan="3"> <ul style="list-style-type: none"> ✓ Permitted - Minor miss of standalone weeds (<5 per 100m²) × Not Permitted - Patches comprised of multiple weeds × Not Permitted - Repeated incidences of missed standalone weeds or loose weed material through Town Centre × Not Permitted – Weeds taller or wider than 200mm (missed treatment) </td> </tr> </tbody> </table> <p>Weed treatment shall not damage tree bark or exposed roots or result in tree damage from basal uptake of Agrichemicals or Organic Herbicides by feeding roots.</p> <p>There shall be no cut weed material present.</p> <p>An audit tolerance will be applied to quality auditing to make allowance for minor and non-material service delivery ‘misses’ in accordance with the criteria specified in Table 1.</p>	Level of Service	High Profile	Medium Profile	Low Profile	Work Treatment	Agrichemical (Glyphosate); Organic Herbicide, Organic Herbicide + Agrichemical (Glyphosate), Thermal, Mechanical, Innovation (Low Carbon)			Weed Management – Town Centre (B,C) (including Tree Circles)				Audit Tolerance Minor and non-material missed weed treatment Town Centre (B,C).	<ul style="list-style-type: none"> ✓ Permitted - Minor miss of standalone weeds (<5 per 100m²) × Not Permitted - Patches comprised of multiple weeds × Not Permitted - Repeated incidences of missed standalone weeds or loose weed material through Town Centre × Not Permitted – Weeds taller or wider than 200mm (missed treatment) 			<p>Weeds</p> <ul style="list-style-type: none"> • All weeds within Town Centre (B,C) treated (factoring audit tolerance). • No weeds (>) greater than 200mm height or width (as a result of a missed treatment). • No tree damage from tree circle weeds treatment. • No cut weed material present. 		
	Level of Service		High Profile	Medium Profile	Low Profile																	
Work Treatment	Agrichemical (Glyphosate); Organic Herbicide, Organic Herbicide + Agrichemical (Glyphosate), Thermal, Mechanical, Innovation (Low Carbon)																					
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C2.2 Edge Management Targets (Town Centre (B,C))	<p>Edges</p> <p>The Supplier shall treat all edges within Town Centre (B,C) - Road corridor, Plazas, and Carparks - at each scheduled visit. There shall be no edges taller than 200mm or treated edges wider than the maximum edge widths in Table 2.</p> <p><i>Table 2 – Maximum Edging Clearance Targets – Town Centre (B,C)</i></p> <table border="1"> <thead> <tr> <th>Level of Service</th> <th>High Profile</th> <th>Medium Profile</th> <th>Low Profile</th> </tr> </thead> <tbody> <tr> <td>Work Treatment</td> <td colspan="3">Agrichemical (Glyphosate); Organic Herbicide, Organic Herbicide + Agrichemical (Glyphosate), Thermal, Mechanical, Innovation (Low Carbon)</td> </tr> <tr> <td colspan="4">Edging – Town Centre (B,C) (including Tree Circles)</td> </tr> <tr> <td>Maximum treated edge width</td> <td><50mm</td> <td><100mm</td> <td><125mm</td> </tr> <tr> <td>Audit Tolerance Minor and non-material missed edge treatment Town Centre (B,C).</td> <td colspan="3"> <ul style="list-style-type: none"> ✓ Permitted - Minor miss of standalone edge sections (<1m long) × Not Permitted - Repeated incidence of missed edges through Town Centre × Not Permitted - Treated edge width > maximum target width × Not Permitted – Edges taller or wider than 200mm (missed treatment) </td> </tr> </tbody> </table> <p>Maximum tree circle diameter (<) less than 700mm.</p> <p>There shall also be no cut edge material present.</p> <p>An audit tolerance will be applied to quality auditing to make allowance for minor and non-material service delivery ‘misses’ in accordance with the criteria specified in Table 1.</p>	Level of Service	High Profile	Medium Profile	Low Profile	Work Treatment	Agrichemical (Glyphosate); Organic Herbicide, Organic Herbicide + Agrichemical (Glyphosate), Thermal, Mechanical, Innovation (Low Carbon)			Edging – Town Centre (B,C) (including Tree Circles)				Maximum treated edge width	<50mm	<100mm	<125mm	Audit Tolerance Minor and non-material missed edge treatment Town Centre (B,C).	<ul style="list-style-type: none"> ✓ Permitted - Minor miss of standalone edge sections (<1m long) × Not Permitted - Repeated incidence of missed edges through Town Centre × Not Permitted - Treated edge width > maximum target width × Not Permitted – Edges taller or wider than 200mm (missed treatment) 			<p>Edges</p> <ul style="list-style-type: none"> • All edges within Town Centre (B,C) treated (factoring audit tolerance). • Treated edge width (<) less than maximum edge width. • No edges (>) greater than 200mm height or width. • Maximum tree circle diameter (<) less than 700mm. • No tree damage from tree circle edge treatment. • No cut edge material present.
Level of Service	High Profile	Medium Profile	Low Profile																			
Work Treatment	Agrichemical (Glyphosate); Organic Herbicide, Organic Herbicide + Agrichemical (Glyphosate), Thermal, Mechanical, Innovation (Low Carbon)																					
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Audit Tolerance Minor and non-material missed edge treatment Town Centre (B,C).	<ul style="list-style-type: none"> ✓ Permitted - Minor miss of standalone edge sections (<1m long) × Not Permitted - Repeated incidence of missed edges through Town Centre × Not Permitted - Treated edge width > maximum target width × Not Permitted – Edges taller or wider than 200mm (missed treatment) 																					

C – Urban Streetscape Edging & Weed Management – Performance Technical Specification

Clause	Clause Component	Extent of Works	Specification	Post-Treatment Technical KPI(s)
<p>C3 Agrichemicals & Organic Herbicides</p>	<p>C3.1 Compliance</p>	<p>All Scheduled Locations & Assets</p>	<p>Compliance</p> <p>The Supplier shall comply with best practice industry standards, legislative requirements and Auckland Council Plans and Policies related to the use of Agrichemicals.</p> <p>Industry Standards</p> <ul style="list-style-type: none"> NZS 8409 Management of Agrichemicals <p>Policies and Plans</p> <ul style="list-style-type: none"> Operative Auckland Unitary Plan Operative Auckland Air, Land and Water Plan <p>Legislative requirements include:</p> <ul style="list-style-type: none"> Hazardous Substances and New Organisms Act 1996 Resource Management Act (RMA) 1991 Health and Safety at Work Act 2016 and associated regulations <p>Auckland Council Plans and Policies include:</p> <ul style="list-style-type: none"> Regional Pest Management Plan (RPMP) - Mahere Whakahaere Kīrearea ā-Rohe (www.aucklandcouncil.govt.nz/plans-projects-policies-reports-bylaws/our-plans-strategies/topic-based-plans-strategies/environmental-plans-strategies/Pages/regional-pest-management-plan.aspx) Auckland Council Weed Management Policy - Kaupapa Here Ngaki Tarutaru (www.aucklandcouncil.govt.nz/plans-projects-policies-reports-bylaws/our-policies/Pages/weed-management-policy.aspx) Kauri Die back Standard Operating Procedure (SOP). <p>The Principal will notify the Supplier of any changes in such policies and procedures and the Supplier shall immediately comply with all such changes.</p>	<p>Compliance</p> <ul style="list-style-type: none"> Supplier fully complies with best practice industry standards, legislative requirements and Auckland Council Plans and Policies when delivering contract services.
	<p>C3.2 Use of Agrichemicals & Organic Herbicides</p>		<p>C3.2.1 Management & Applicator Qualifications</p> <p>For Supplier personnel managing the application of Agrichemicals, the minimum qualification shall be Registered Chemical Applicator (RCA) to:</p> <ul style="list-style-type: none"> Implement and monitor spray plans Provide direction to staff applying Agrichemicals Make day-to-day decisions in relation to Agrichemical application Apply Agrichemicals in a safe, responsible, and effective way with minimal adverse impact on human and environmental health. Meet legislative and Council obligations. <p>For Supplier personnel applying Agrichemicals under direct supervision of a RCA, the minimum qualification shall be Growsafe (basic) and for applicators not under the direct supervision of a RCA, the minimum qualification shall be Growsafe (standard).</p> <p>The Supplier shall provide a list of all persons who are qualified to undertake spraying at the commencement of the Agreement period and provide an updated list following any staff changes. The Principal may request copies of certificates of registration for inspection at any time.</p>	<p>Management & Applicator Qualifications</p> <ul style="list-style-type: none"> Supplier personnel qualified to manage and implement Agrichemical and Organic Herbicide programmes. Supplier personnel lists and qualifications provided at contract commencement and updated annually.

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Clause	Clause Component	Extent of Works	Specification	Post-Treatment Technical KPI(s)
C3 Agrichemicals & Organic Herbicides	C3.2 Use of Agrichemicals & Organic Herbicides	All Scheduled Locations & Assets	<p>C3.2.2 Product and Application Records and Reporting</p> <p>The Supplier shall provide and maintain a register of Agrichemical and Organic Herbicide products used for contract operations.</p> <p>The Supplier shall maintain spray records (format and content shall approved by the Principal) for all Agrichemical and Organic herbicide applications.</p> <p>The Supplier shall record and report all usage of Agrichemicals and Organic Herbicides to the Principal in accordance with Schedule 9.</p> <p>C3.2.3 Storage & Handling</p> <p>Agrichemicals and Organic Herbicides shall be stored and handled in accordance with good management practices, as described in New Zealand Standard 8409: 2004 Management of Agrichemicals so there is no contamination of land, groundwater, surface waters and non-target areas.</p> <p>C3.2.4 Programme Delivery</p> <p>The Supplier shall deliver services in accordance with General Specification – Clause 6 – Working Hours. Programme delivery shall consider factors including, but not limited to, public use, weather conditions, traffic management and public safety. Application of Agrichemicals and Organic Herbicides shall be informed by the Manufacturers’ recommendations.</p> <p>The Supplier shall undertake spraying of Agrichemicals and Organic Herbicides with care and accuracy.</p> <p>No spray marker dye shall be used unless instructed by the Principal (due to consequential public enquiries and potential environmental impact).</p> <p>The Supplier shall ensure work is carried out using a methodology that prevents any spray drift, transfer or leaching onto adjacent property or non-target species or non-target areas.</p> <p>No Agrichemical or Organic Herbicide sprays shall contact non-target trees or vegetation or surfaces which may be damaged by spraying including, but not limited to, turf, tree trunks, basal growth or active growth nodes, surface root plates, or any other living tree part, plants in gardens, or any other vegetation that is not a weed.</p> <p>The Supplier shall ensure Agrichemical and Organic Herbicide applications do not cause spillage, leaching, runoff, contamination or pollution of adjacent property, water courses or drainage systems.</p> <p>C3.2.5 Plant & Equipment</p> <p>All plant and equipment used in the application of Agrichemicals and Organic Herbicides shall be properly maintained and fitted with an effective anti-drift guard such as a ‘spray cone shield’ or a ‘drift guard’ or equivalent to prevent spray drift onto neighbouring areas or plants, a pressure-regulating device, and a spray nozzle that minimises spray drift.</p> <p>All plant and equipment used to apply Agrichemicals and Organic Herbicides shall meet New Zealand Standards regarding maximum operating noise levels and the Health and Safety at Work Act 2016.</p> <p>Where spraying is being undertaken alongside roads, vehicles associated with the spraying shall display prominent signs on both the front and back of the vehicle, advising that spraying is in progress. Where spraying is undertaken at a location (e.g., Town Centre), signs shall be placed at key entry and/or exit points prior to, during and after commencement of treatments to inform the public that spraying is in progress.</p> <p>The Supplier must ensure all operators are provided with at least the minimum level of safety equipment required.</p>	<p>Product & Application Records and Reporting</p> <ul style="list-style-type: none"> Register of Agrichemical and Organic Herbicide maintained and reported. <p>Storage and Handling</p> <ul style="list-style-type: none"> Agrichemical and Organic Herbicide products stored and handled in accordance with New Zealand Standard 8409: 2004 Management of Agrichemicals. <p>Programme Delivery & Plant and Equipment</p> <ul style="list-style-type: none"> Supplier factors in and manages all delivery variables during implementation of the works programme informed by the number and frequency of specified treatments. The Supplier’s methodology (including plant and equipment) facilitates delivery of the work programme safely and without excessive noise or damage to assets.

C – Urban Streetscape Edging & Weed Management – Performance Technical Specification

Clause	Clause Component	Extent of Works	Specification	Post-Treatment Technical KPI(s)
C3 Agrichemicals & Organic Herbicides	C3.2 Use of Agrichemicals & Organic Herbicides	All Scheduled Locations & Assets	<p>C3.2.6 Difficult-to-control Weeds</p> <p>The Supplier shall notify the Principal of locations where weeds (e.g., nutgrass) are unable to be successfully managed using glyphosate or Organic Herbicide. The Supplier shall present the Principal with an 'alternate control methodology' proposal including, but not limited to:</p> <ul style="list-style-type: none"> • Weed species • Location(s) and level of infestation (area of town centre or length of road corridor). • Alternate product, methodology and programme <p>An alternate product or methodology shall be approved by the Principal.</p> <p>The Supplier shall notify the Principal prior to commencement of auditing of the affected site(s) for any auditing dispensation to be considered. Dispensation shall be provided at the discretion of the Principal.</p> <p>C3.2.7 Rectification of Damage</p> <p>It shall be the sole responsibility of the Supplier to 'make good' any non-target vegetation damage, road corridor or town centre asset damage or pollution or contamination resulting from treatment operations at their own cost. Damage shall be reinstated or repaired so that the asset condition is returned to a standard at least equivalent to the original condition. The Supplier will be held responsible for any claims or compensation arising from his/her actions or omission in accordance with General Terms clause 11.2 – Defective Services.</p> <p>Any area of 'over-spray' from urban road edge or verge that exceeds the maximum specified clearance distances will be deemed to be damaged and shall be reinstated at the Supplier's expense (Schedule 1a – General Specification (clause 12)).</p> <p>The Supplier shall notify the Principal of locations, areas or assets that have been historically 'over sprayed' and work with the Principal to stop further damage.</p>	<p>Difficult to Control Weeds</p> <ul style="list-style-type: none"> • The Supplier uses a methodology approved by the Principal to manage 'difficult to control' weeds on a case-by-case basis. <p>Rectification of Damage</p> <ul style="list-style-type: none"> • The Supplier repairs or reinstates damage or replaces assets damaged during delivery of contract services.
C4 'No Spray' Register & Public Notification	C4.1 'No Spray' Register'	All 'No spray' locations	<p>'No Spray' Register</p> <p>The Supplier will be responsible for implementing the No Spray Register maintained and updated by Council. The 'No Spray' Register includes, but is not limited to, locations where private or commercial property owners or occupiers have requested that no Agrichemicals be used on road frontages bordering the property boundary. The register may also include 'No Spray' frontages for parks, reserves, or road reserves where weed management is not be undertaken using Agrichemicals.</p> <p>There shall be no spraying of any location included in the 'No Spray Register'. Non-compliance may result in reinstatement of damage and/or application of costs to the affected parties in accordance with General Specifications - Clause 12 - Asset Care, Damage Reinstatement.</p> <p>Public Notification</p> <p>The Supplier (at its own cost) shall notify adjoining properties at 'no spray' boundaries on the 'no spray' register that a spray plan has been developed (and is available on request) at least two days' notice prior to application.</p> <p>Notification shall be in writing by way of:</p> <ul style="list-style-type: none"> • publication in the relevant local newspaper, or • other approved methodology e.g., information or letterbox drops. <p>The format and content of public notices shall be in accordance with Auckland Transport policy and guidelines and shall include, but is not limited to:</p> <ul style="list-style-type: none"> ✓ Supplier's name ✓ Details of the spray locations ✓ Proposed period of spraying ✓ Agri-chemical product ✓ Notice that private berms will not be sprayed. <p>The notice shall be published 6 weeks prior to spraying.</p>	<p>'No Spray' Register'</p> <ul style="list-style-type: none"> • No spraying of any location in the 'No Spray Register'. • Public notified of spraying using an approved public notice, approved guidelines, and specified timeframes. • The Supplier repairs or reinstates damage or replaces assets damaged during spraying of locations included in the 'No Spray Register'.

C – Urban Streetscape Edging & Weed Management – Performance Technical Specification

Technical Specification Clause	Clause No	Extent of Works	Specification	Post-Treatment Technical KPI(s)
C5 Weed Control Treatments	C5.1 – Glyphosate	All Scheduled Locations & Assets	<p>C5.1.1 Glyphosate Product</p> <p>The following glyphosate products have been assessed by Auckland Council and approved for use by Suppliers:</p> <ul style="list-style-type: none"> • Agpro Green Glyphosate 510 • Agpro Glyphosate Gel 120 • Ravensdown Glyphosate G360 • Ravensdown Glyphosate 540 <p>Auckland Council may assess the formulation of the glyphosate products used in its contracts and advise whether the products are still safe to use. If the Supplier proposes to use an alternate glyphosate product, it must be reviewed by Council and approved by Auckland Transport and the Principal prior to use.</p> <p>Glyphosate products shall not contain the surfactant polyoxyethylene tallow amine (POEA) due to the potential for transport into surface water and groundwater.</p> <p>C5.1.2 Glyphosate Application</p> <p>Glyphosate shall be applied in accordance with technical specifications clauses C1 – C4.</p> <p>The Supplier shall use a methodology and spray programme that facilitates control of weeds in accordance with the clearance targets in technical specifications clauses C1 and C2.</p> <p>Where glyphosate is specified as part of a combined Organic Herbicide + Agrichemical (glyphosate) treatment option (Schedule 3 - Work Programme), glyphosate shall be applied no more than three times annually. Application periods shall be restricted to spring (Sep-Nov) and autumn (Mar-Apr) to assist management of 'growth flush' periods.</p> <p>C5.1.3 Glyphosate Treatment Efficacy</p> <p>There shall be evidence of weed 'die back' within 14 calendar days of spraying and 100% weed or edge control within 31 calendar days of treatment. This 'die back' period will be used to inform the timing of auditing and effectiveness of the work treatment.</p>	<p>Glyphosate</p> <ul style="list-style-type: none"> • The Supplier uses an approved product in accordance with clauses C1 – C4. • The Supplier methodology results in effective weed and edge control. • When glyphosate is part of a combination Organic Herbicide + Agrichemical (glyphosate) treatment, it is not applied more than 3 times annually and only in the periods Sep – Nov and Mar – Apr. • Auditing is informed by a 14-calendar day 'die back' evidence period and a 31-calendar day control period.
	C5.2 – Organic Herbicide	All Scheduled Locations & Assets	<p>C5.2.1 Organic Herbicide Product</p> <p>Organic Herbicide products shall be a 'plant-derived' oil-based, acetic acid based or fatty acid-based weed control product with an emulsifier and must be reviewed by Council and approved by Auckland Transport and the Principal prior to use.</p> <p>C5.2.2 Organic Herbicide Application</p> <p>Approved Organic Herbicides shall be applied in accordance with clauses C1 – C4.</p> <p>The Supplier shall use a methodology and spray programme that facilitates control of weeds in accordance with the clearance targets in technical specifications clauses C1 and C2.</p> <p>C5.2.3 Organic Herbicide Treatment Efficacy</p> <p>There shall be evidence of weed 'die back' within 7 calendar days of spraying and 100% weed or edge control within 31 calendar days of treatment. This 'die back' period will be used to inform the timing of auditing and effectiveness of the work treatment.</p>	<p>Organic Herbicide</p> <ul style="list-style-type: none"> • The Supplier uses an approved product in accordance with clauses C1 – C4. • The Supplier methodology results in effective weed and edge control. • Auditing is informed by a 7-calendar day 'die back' evidence period and a 31-calendar day control period.

C – Urban Streetscape Edging & Weed Management – Performance Technical Specification

Technical Specification Clause	Clause No	Extent of Works	Specification	Post-Treatment Technical KPIs
C5 Weed Control Treatments	C5.3 – Thermal (Hot Water/Steam)	All Scheduled Locations & Assets	<p>C5.3.1 Thermal Methodology</p> <p>The thermal methodology may be either steam or hot water. If an insulating foam is used as part of the methodology, the foam product shall be approved by the Principal and foam volumes recorded and reported monthly.</p> <p>The control system shall consider delivery of a minimum temperature of 100°C at the weed control point for a sufficient period to cause intracellular water expansion and cell membrane rupture.</p> <p>The treatment methodology shall not result in contamination of the downstream road corridor or town centre environment (e.g., runoff into storm water system).</p> <p>Care shall be taken when moving hoses and associated equipment across pedestrian areas and that appropriate signage shall be placed to eliminate tripping hazards.</p> <p>When refilling water tanks from a hydrant, filling equipment including standpipe, back flow preventer and meter shall be provided by the Supplier. The Supplier shall record and report all water volumes monthly in accordance with Schedule 9 Reporting requirements.</p> <p>C5.3.1 Thermal Treatment Efficacy</p> <p>There shall be evidence of weed ‘die back’ within 2 calendar days of treatment and 100% weed or edge control shall be achieved within 14 calendar days of treatment. This ‘die back’ period will be used to inform the timing of auditing.</p>	<p>Thermal (Hot Water/ Steam)</p> <ul style="list-style-type: none"> The Supplier methodology results in effective weed and edge control. If the Supplier methodology uses an approved foam insulating product it is approved by the Principal. The minimum temperature at point of discharge is 100°C. Foam volumes are recorded and reported monthly. Water volumes are recorded and reported monthly. Auditing is informed by a 2-calendar day ‘die back’ evidence period and a 14-calendar day control period.
	C5.4 – Mechanical (including Edging)		<p>All weeds shall be mechanically removed using a mechanical methodology such as weed eaters/line trimmer (or similar plant and equipment), ‘grubbing out’ or chipping out weeds mechanically, or by hand removal. Where practicable, the methodology shall support removal of the complete weed root system.</p> <p>Any weed trimmings created shall be collected by sweeping or blowing, picked up and disposed off-site to an approved green waste management facility. Under no circumstances shall the Supplier temporarily stockpile weed material on site.</p> <p>The Supplier shall carry out good weed hygiene practice, ensuring that work activities do not result in the transfer or spreading of any weeds.</p>	<p>Mechanical</p> <ul style="list-style-type: none"> The Supplier methodology results in effective weed and edge control. No cut weed or edge debris left on site. No transfer of weeds between sites.
	C5.5 – Innovation (Low Carbon)		<p>C5.5.1 Innovation (Low Carbon) Methodology</p> <p>The Innovation (Low Carbon) methodology shall not use Agrichemicals or Organic Herbicides.</p> <p>The Innovation (Low carbon) methodology shall have carbon emissions that are >50% lower than other specified treatments. Carbon emissions shall be measured and benchmarked in year 1 in accordance with Schedule 10 (clause 4.10)</p> <p>The methodology shall be agreed with and approved by the Principal.</p> <p>C5.5.2 Innovation (Low Carbon) Treatment Efficacy</p> <p>The ‘evidence of die back’ and 100% control periods shall be agreed with and approved by the Principal. This ‘die back’ period will be used to inform the timing of auditing and effectiveness of the work treatment.</p>	<p>Innovation (Low Carbon)</p> <ul style="list-style-type: none"> The Supplier methodology results in effective weed and edge control. Auditing is informed by an agreed ‘die back’ evidence period and an agreed control period.

Appendix 2 Log of communications with mana Whenua

Urban Streetscape: Edging and Weed Management Iwi consultation/Engagement record

Date	Engagements	Outcome	CF Attendees
24/11/2021	Presentation of the weed control options at PSR Hui for South and Central Area	Suggested to consider the potential to use salt in boiling water for weed killing was raised. There was a good discussion as outlined in the meeting minutes.	Kirk, Daya, Laura (Morphum)
26/11/2021	FU email by Daya to the PSR South/Central Mana whenua briefing the items discussed, requesting the feedback and one-on-one session.	No response received.	
2/12/2021	Presentation of the weed control options at PSR Hui for North and Eastern Area		Kirk, Daya, Laura (Morphum)
14/12/2021	FU email by Daya to the PSR North/Eastern Mana whenua briefing the items discussed, requesting the feedback and one-on-one session.	No response received.	
17/02/2022	Email by Daya to Desiree Tukutama (Kaitiaki Forum) requesting for feedback on the shortlist of options. The email included the memo to the local boards 17/2/2022	No response received.	
17/02/2022	Email by Daya to IMSB (Theresa and Miriana) requesting for feedback on the shortlist of options. The email included the memo to the local boards 17/2/2022. A meeting was organised with IMSB on 1/4/2022 to explain the process we followed.		Jade, Chris, Jen and Daya
18/03/2022	Memo to Mana whenua Kaitiaki Forum asking if any suggestions on the methods, if needed one on one session and would like to present the views in the local board workshops.	No response received.	
1/04/2022	Meeting with IMSB- Miriana and Theresa.	AC explained the consultation undertaken with the Mana Whenua and efforts made to engage further. Also, asked if there is any alternative way we could approach to get a	Jade, Chris, Jen and Daya

		meaningful consultation. The consensus was the attempts made were adequate.	
17/08/2022	Email to Maori and Pacifika businesses by Procurement notifying the tender release.		Procurement.

Appendix 3 Contractor Health and Safety Responses

Table 13: Contractor Responses for health and safety. The contractors have not been named and are instead referred to as C#. All ratings were based on a risk matrix of likelihood against consequence. Ratings were based on a 0-4 scale with the highest possible score a 16 and 0 as the lowest.

Operator H&S	C1	C2	C3	C4	C5	C6	Average
Glyphosate	2	2	4	4	2	1	2.5
Organic Herbicide	2	2	2	4	2	1	2.166667
Thermal	3	2	3	2	3	2	2.5
Mechanical	2	2	2	4	3	2	2.5
Public H&S							
Glyphosate	2	2	2	4	2	2	2.333333
Organic Herbicide	2	2	4	4	2	3	2.833333
Thermal	2	2	2	2	2	1	1.833333
Mechanical	4	2	3	6	3	4	3.666667

MORPHUM

environmental

NEW ZEALAND

Auckland

Level 4, 18 Sale St,
Auckland Central, Auckland 1010

Tel: +64 9 377 9779

Nelson

3 Wensley Road, Richmond 7020

Wellington

9 Tory Street, Te Aro,
Wellington 6011

Tel: +64 4 802 4987

Waikato

65 Victoria St, Hamilton 3204

AUSTRALIA

Melbourne

Level 17, 31 Queen Street,
Melbourne 3000

Tel: +61 3 9111 5640

info@morphum.com | www.morphum.com