Alternative Methods of Amenity Weed Control in Partnership with Hampshire Highways

2022

Hampshire Highways

MILESTONE INFRASTRUCTURE
A part of MGroupServices

CHARLTON ENVIRONMENTAL LIMITED

Contents:

Introduction:

Hampshire Highways are responsible for maintaining approximately 8670km of principal, classified, and unclassified roads throughout the geographical area of Hampshire. Excluded from Hampshire Highways' responsibility are the unitary authority areas of Portsmouth and Southampton, and motorway and trunk roads which are the responsibility of Highways England.

Since 2017, this maintenance has been delivered through Milestone Infrastructure (formerly Skanska), its trusted partners, and their subcontractors.

As part of this highway maintenance contract, Milestone infrastructure are responsible for removing weeds from the urban network in Winchester, Rushmoor, Test Valley, Fareham, and East Hampshire. This amounts to 4269km of surfaced street pavements and footways. This figure excludes the addition of paved and non-paved traffic islands, central reservations, and roundabouts, which are also covered within the programme.

Since 2021 this aspect of the contract has been delivered by Charlton Environmental Ltd, a specialist amenity weed control contractor, who use handheld applicators to walk the network and accurately treat active weed growth once per year with glyphosate.

Glyphosate Background & Reasons for Trialing Alternative Methods:

In 2015 the International Agency for Research on Cancer (IARC), an agency of the World Health Organisation (WHO) classified glyphosate as a group 2A carcinogen; "probably carcinogenic to humans". This has led to much controversy in media outlets and political pressure on users of glyphosate in both agriculture and amenity to review their usage.

It is important to note that the IARC only evaluates the potential of a chemical, physical agent, or lifestyle factor to cause cancer by means of reviewing the available scientific evidence. It does not look at the dosage or exposure level required for that substance, agent, or lifestyle factor to indeed have a carcinogenic effect. To add perspective to this, sunlight in the form of UV rays is classified as a group 1 (known to be carcinogenic) by the IARC, though avoiding sunlight entirely would have serious detrimental effects on human health.

The IARC monographs can be viewed on their website here:

https://monographs.iarc.who.int/list-of-classifications

By examining the data and querying '2A' in the search bar we can view other substances, physical agents, and lifestyle factors which the IARC classify as "probably carcinogenic to humans". These include - but are not limited to - anabolic steroids, occupational exposure as a hairdresser or barber, emissions from high temperature frying, working night shifts, consumption of red meat, and drinking hot beverages above 65°.

Subsequent to the IARC's evaluation, in 2016, the WHO in conjunction with the Food & Agriculture Organisation of the United Nations (FAO) concluded that "glyphosate is unlikely to pose a carcinogenic risk to humans from exposure through the diet".

The European Chemicals Agency then in 2017 concluded that the "available scientific evidence did not meet the criteria to classify glyphosate as a carcinogen, as a mutagen or as toxic for reproduction", and more recently in 2020 the US Environmental Protection Agency reaffirmed its stance that "there are no risks of concern to human health when glyphosate is used in accordance with its current label. EPA also found that glyphosate is unlikely to be a human carcinogen"

Despite the above, there have been several successful claims in the USA against Bayer, who purchased Monsanto in 2018, focusing on their product, 'Roundup', which contains glyphosate, contributing to the claimant's non-Hodgkin's lymphoma.

The Pesticide Action Network (PAN UK), cites that glyphosate, in combination with surfactants found in glyphosate formulations, can have adverse effects on kidneys, can lead to reproductive and developmental issues, is an endocrine disruptor, can affect neurological nerve cells and interferes with the immune system.

Members of the public and local councilors across Hampshire have expressed concern over the use of the substance, not only due to its potential impact on human health but also on local biodiversity.

This has led the council to review its use of glyphosate on the network by way of a trial to better understand what alternatives are available. Are they practical? Are they safer for both operatives and public? Are they cost effective?

A summary report by Oxford Economics which looked at the impact of an all-out ban on glyphosate usage on the UK's road network determined that the financial impact of some alternative methods could increase the average household council tax bill by up to £7.80.

They also review the economic impact on agriculture and on railways. The summary reports can be viewed here:

https://www.oxfordeconomics.com/recent-releases/The-impact-of-a-glyphosate-ban-on-the-UK-economy

However, with a global glyphosate shortage on the horizon for the 2022 season and prices of glyphosate products rapidly escalating as a result, there could be a balancing effect on the cost of alternative solutions.

Why Treat Weeds at all?

This is a question that the council are commonly asked. Why clear weeds? Why not leave weeds on the street pavement surfaces and let them flourish? Some wildflowers not only look appealing, but create habitat, food sources for pollinators and lead to an overall increase in biodiversity which can only be a good thing:

Some weeds such as horsetail (Equisetum arvense), buddleja and other woody perennials can have a detrimental effect on the highway surface. This can lead to costly resurfacing repairs and potential disruption on the network which could have been prevented had the weeds been controlled. Figure 1 below shows damage to a tarmac surface caused by horsetail in Rushmoor district.

Fig. 1 [Horsetail Growth on Tarmac]

Under the Weeds Act 1959 the council has a responsibility to prevent the spread of spear thistle, creeping thistle, curled leaf dock, broad leaved dock, and ragwort, which can all be found commonly growing throughout the network

Under the wildlife and countryside act 1981 the council has a responsibility to prevent the spread into the wild of 52 invasive non-native plant species as listed in schedule 9. These include Japanese Knotweed, Giant Knotweed, Himalayan Balsam and Montbretia, all of which the council is aware of occurrences within the network.

Some plants can be harmful to human health. There are reported instances of Giant Hogweed on the Hampshire Highway network which can cause severe skin burns. It is also common to observe nightshade, hemlock, and other plants poisonous to humans. There is a particular risk to children and animals when these species are found to be growing from the highway surface or in highway verges.

Weed growth can build up over time and capture detritus and litter, this can make it difficult for machine sweepers to collect litter effectively which, if left unmanaged can encourage rodents and when combined, creates an unkempt appearance.

An abundance of vegetation in highway gullies and channels can inhibit the flow of rainwater and in extreme circumstances can increase the likelihood of flooding. Figure 2 below shows a significant build-up of weed grasses in a drainage channel in Gosport.

Fig. 2 [Weed Growth in Drainage Channel]

The Aims of this Study:

- To identify viable alternative methods of treating and removing weeds from the highway network
- To measure the effectiveness of the alternatives procured both in the short term and long term
- To measure the safety and limitations of the alternatives procured for operatives and members of the public
- Analyse the costs of the alternative methods against 'doing nothing' and the use of glyphosate. Could the current cost to the taxpayer be reduced through alternative methodology? Or does an increase in cost to the taxpayer offer overall best value?

Methods of Control to be Included:

Do Nothing

An area of network will be left completely untreated for the 2022 season. The council will audit this area regularly to determine weed growth levels, impacts and public response.

Application of glyphosate

An adjacent area of the network will be treated with glyphosate once in the 2022 season as normal.

Application of Acetic Acid (vinegar)

A product named 'New Way Weed Spray' will be applied to an adjacent, similarly sized area to the above. This will be a pedestrian operated spray application similar to applying glyphosate, however the applicator itself will be a more conventional 15L hydraulic pump knapsack, rather than an electronic, lightweight CDA machine. This is because a higher volume output is required with this product.

Application of Pelargonic / Nonanoic Acid

A product containing the above ingredients will be sourced and applied to an adjacent, similarly sized area to the above. This will be a pedestrian operated spray application similar to applying glyphosate, however the applicator itself will be a more conventional 15L hydraulic pump knapsack, rather than an electronic, lightweight CDA machine. This is because a higher volume output is required with this product.

Upon further investigation, it was found that these products are not approved for use on hard surfaces to control weeds, and therefore this option was removed from the trial.

Hot Foam

A machine will be hired in from “Weedingtech” who manufacture and distribute the Foamstream system in the UK. Operatives will be trained to use the machine which is mounted on a vehicle at all times. We then need to employ a team of at least 2 operatives to operate, as one operative will be in charge of the vehicle, another applying the foam product, and potentially a third responsible for signing / guarding / public awareness; subject to risk assessment.

As this method is vehicle mounted, traffic management and potential rolling lane closures will need to be factored in. There is an operational constraint to be considered when maneuvering the applicator hose around parked cars and into remote footways whilst attached to the vehicle, and as the machine uses approx. 700 liters of water per 65 minutes, we need to factor in operational downtime whilst re-filling the water tank on a potentially hourly basis.

Mechanical Removal

A pedestrian operated; self-propelled machine will be hired with a weed brush attachment. This will brush weeds from the pavement surface at surface level. Footpath closures may need to be in effect for public safety whilst this takes place due to the size of the machine and potential for flying objects. Due to the size of the machine, it will not be possible for it to reach into gullies where parked cars are present against the curb. So, there may need to be parking suspensions in operation, or the method can be integrated with other methods for hard-to-reach areas. Arisings will require removal from site and disposal to a suitable green waste transfer facility.

Burning

The “RIPAGREEN” system, Is a high velocity heating system powered by propane combustion. The plant leaf needs only to be briefly exposed to a high temperature to cause terminal damage making this a faster process than foam or mechanical removal. Using the “mobility kit,” a 5kg propane bottle is held in a backpack worn by the operative and should last up to 2 hours at a cost of £35 per cannister. In a 6-hour working shift, therefore, one operative should use 3 cannisters at a cost of £105 per day.

Integrated

The manufacturer / distributor of both the sweeping machine and the weed burner have advised that their products for mechanical removal and weed burning should form part of an integrated weed management strategy and should not be used in isolation when compared with synthetic pesticides. The council currently only undertake one visit to each area annually and so whilst these methods should still be trialed in isolation for fair comparison, the integrated approach should also be trialed with a mechanical sweep of young weeds/detritus taking place in early March with a follow up burn in tandem the remaining trials in late May. We will need to add in additional monitoring to judge the level of weed growth observed prior to the May trials to ascertain whether the early sweep has significantly impacted the level of growth.

Electricity

We explored the option of "ROOTWAVE" to treat weeds using electricity. The methodology is like using foam, with a vehicle mounted generator attached to a handheld lance. Unfortunately, the ROOTWAVE system is not currently available to hire, and the purchase cost is approximately £18,000.00. Therefore, ROOTWAVE have been approached with an enquiry as to the possibility of a paid demonstration of the system. ROOTWAVE were unfortunately not eager to engage in a demonstration of their equipment. They explained that the system would be unsuitable in a highways scenario as it requires a grounding rod to be secured in soft earth to function. The machine then has a limited working area from this grounding rod.

Methodology and Evaluation:

Having experienced requests from members of the public and local councilors during the 2021 weed control season to explore moving away from chemical methods in Petersfield in particular, a decision has been made that the trials should be conducted in Petersfield in 2022. The weed treatment which is annually commissioned by HCC usually runs from 1st May – 31st August, and the trial should be conducted during this period when weed growth is at its most significant, but with due time to monitor the results thereafter. Therefore, the trials will be conducted in Petersfield, week commencing 23rd May 2022. The exception to this will be the early sweep for the integrated approach.

Suitable, similarly sized areas have been identified in Petersfield Causeway Ward, Petersfield Heath Ward, Petersfield Bells Hill Ward, and Petersfield Rother Ward. These three wards have been split into 7 "sub-wards" in order to facilitate the 7 alternative methods. The sub-wards are attached to this document (pg. 16-19).*

**Originally 9 wards were allocated but areas 8 and 9 were later removed due to ROOTWAVE and pelargonic acid being non-viable*

The intention of the trial is to complete the weed control within the sub-wards on all pedestrian footways, kerbs, channels, traffic islands, roundabouts and remote footways using the proposed alternative method assigned to that sub-ward.

As some methods will undoubtably incur more labour than others, and due to the usual weed control programme being paused whilst the trials are conducted, the time allowance will be capped at 5 days. Therefore, all trials will be due to end on close of business, Friday 27th May 2022 regardless of whether the allocated sub ward has been completed. In the event of loss of time due to inclement weather during the week, the trials will be extended into the following week.

We will then be able to evaluate the area covered in the given time and, using the data collected during the period, we can then calculate average outputs in terms of area covered per operative

per day. This can be compared with the other methods to ascertain the most labour efficient method of control.

In addition to the above, we will also evaluate the cost of all consumable items i.e., foam additive, gas, acetic acid etc. against the area covered on a per time and on a per distance basis.

Once the labour and consumable cost is known, the cost per KM of footway covered can be calculated for each method.

It is believed that pedestrian management will need to be in place for some of the trials; the mechanical removal, burning and foam methods. Any additional costs associated with provision for pedestrian management where deemed neccessary will be in addition into the final evaluated costs.

Traffic management will need to be in place for some of the trials where the equipment is permanently fixed to a vehicle i.e. foam. The costs associated with this will be in addition to the final evaluated costs.

Prior to the trials, we will audit the wards to judge levels of weed growth when compared to the integrated approach which will have benefitted from a mechanical sweep in March.

Once the trials have concluded, we will begin monitoring the effectiveness by way of conducting 8 lots of weekly audits, starting on Friday 3rd June 2022. Initially we will be looking at how well the weeds in each of the 7 areas have been controlled on a short-term basis. After these 8 weekly audits have been conducted, we will then conduct audits on a fortnightly basis until 31st October 2022. The purpose of the longer-term audits is to observe the levels of regrowth in the trial areas.

Audits will use the DEFRA scale which can be found in the "Best Practice Guidance Notes for Integrated and Non-chemical Amenity Hard Surface Weed Control (withdrawn)." Roads will be graded as per the tables and images below:

Fig. 3 [Weediness Scale: Slabs – Table]

Weediness scale for slabs:

Criteria			Score	Level	Description
Height (mm)	diameter or length (mm)	Joint coverage (%)			
<10	<50	<10	<3	1	No noticeable weeds
10-50	50-100	0-20	4-6	2	Occasional small weeds
50-100	100-150	20-30	7-9	3	Patchy weed growth with some flowering weeds
100-150	150-200	30-40	10-12	4	Numerous weeds, many flowering, view annoys or irritates public
150-200	200-300	40-50	13-15	5	Numerous large weeds, risk to slip or trip
>200	>300	>50	16-18	6	Numerous large weeds, many tall and flowering,causing obstruction

Fig. 4 [Weediness Scale: Slabs – Images]

Fig. 5 [Weediness Scale: Asphalt – Table]

Weediness scale for asphalt:		Score	Level	Description
Height (mm)	Weed diameter or length (mm)			
<10	<50	2	1	No noticeable weeds
10-75	50-100	3-4	2	Occasional small weeds
75-150	100-150	5-6	3	Patchy weed growth with some flowering weeds
150-200	150-200	7-8	4	Numerous weeds, many flowering, view annoys or irritates public
200=300	200-300	9-10	5	Numerous large weeds, risk to slip or trip
>300	>300	11-12	6	Numerous large weeds, many tall and flowering,causing obstruction

Fig. 6a [Weediness Scale: Asphalt – Images]

Fig. 6b [Weediness Scale: Asphalt – Images]

Reporting and Data Collection:

Data from weed control and other works on the network is currently recorded on the map16 GIS mapping system. For the purposes of the trial a new dashboard will be created within the system showing only the 7 trial areas. Records of work completed will be stored on this system, and a form will be added for collection of data during the audits including the grading applied and supporting photographic evidence to support the grading. Data can then be pulled from the system and analysed so that we can evaluate how the grading changes over time after treatment.

Expected Evaluation Results:

By the end of 2022, an evaluation report will be added to this document detailing the following measures from the trial:

i. The average output from each method calculated using formula:

(time spent / kilometers covered = time to cover 1km),

ii. The cost of consumable items required for the method calculated using formula:

(cost of consumables / kilometers covered = cost of consumable items to cover 1km),

iii. The overall cost of the method per kilometer using a benchmark labour cost and applied as follows:

(cost of consumables per km + labour cost per km = cost to cover 1km),

iv. The short-term effectiveness of each method using the grading methods detailed above,

v. The levels of regrowth observed across all areas and whether they are acceptable,

vi. Any Environmental and Safety related benefits or concerns that might present themselves during the trials,

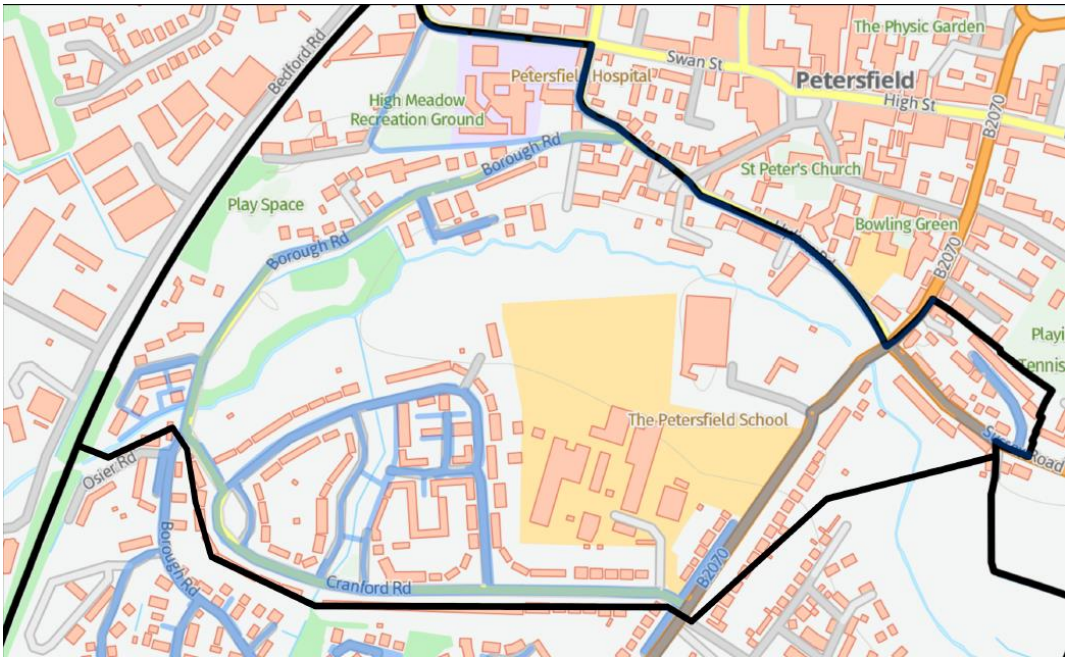
vii. Any operational limitations experienced during the trials,

viii. Any public feedback from the trial including level of complaints regarding excessive weed growth.

Cell Maps:

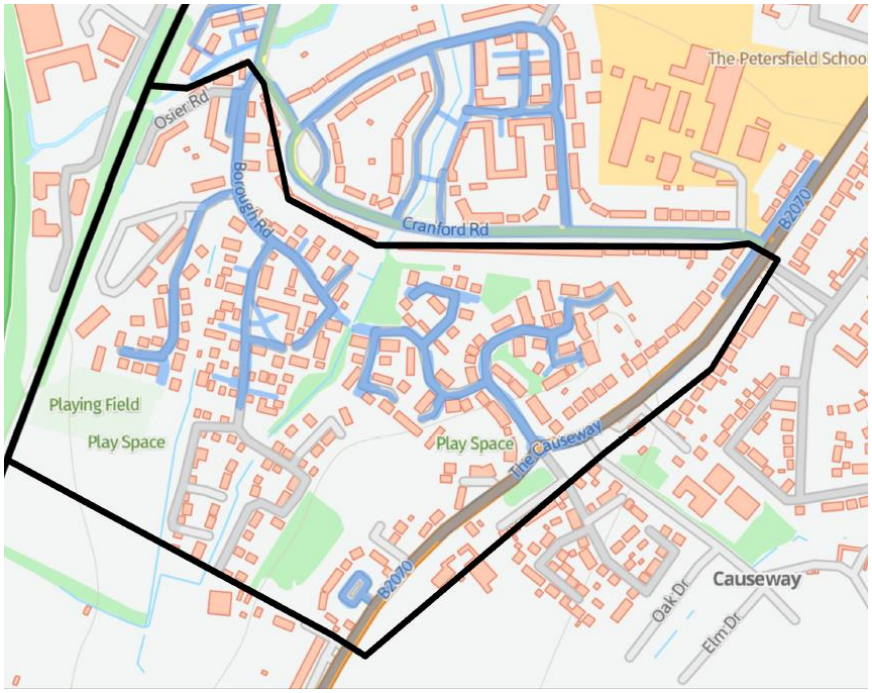
Trial Area 1 – Integrated Approach

[Fig. 7]



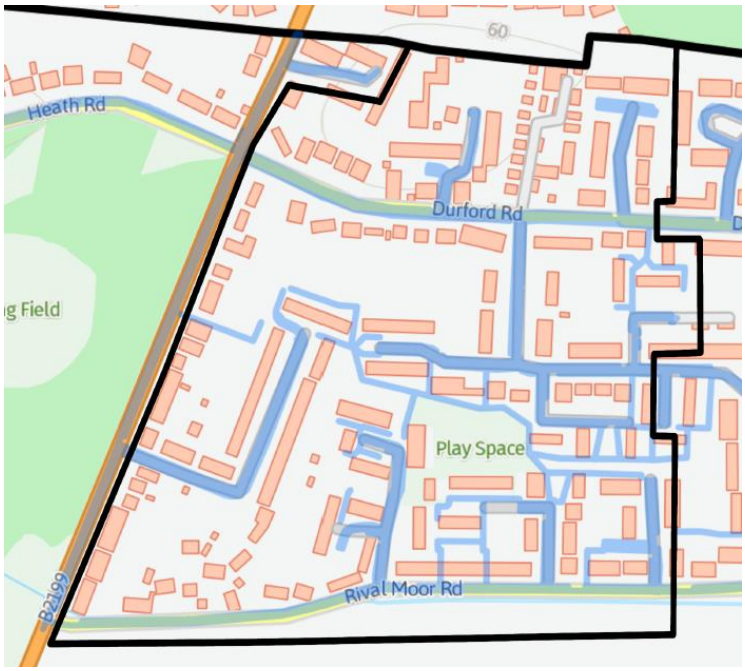
Trial Area 2 – Weed Burn Only

[Fig. 8]



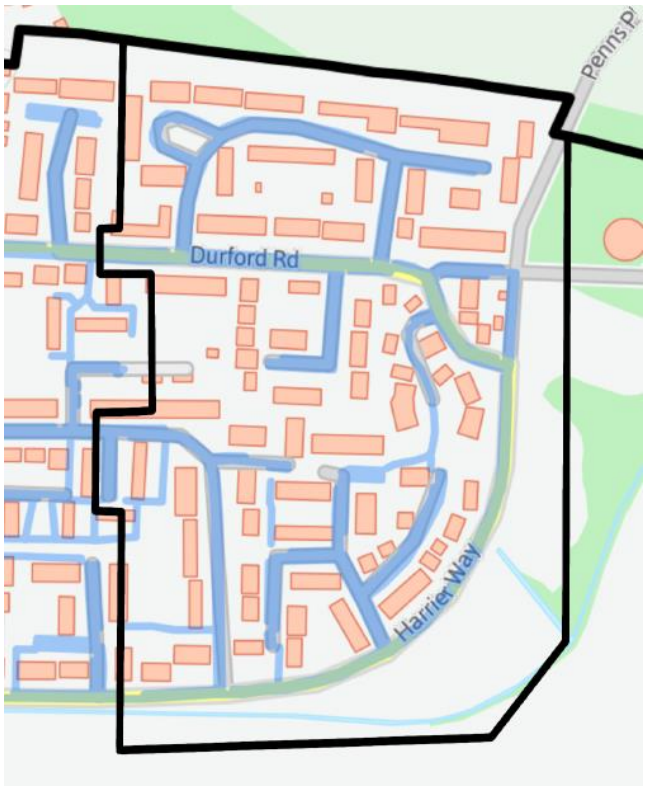
Trial Area 3 – Sweep Only

[Fig. 9]



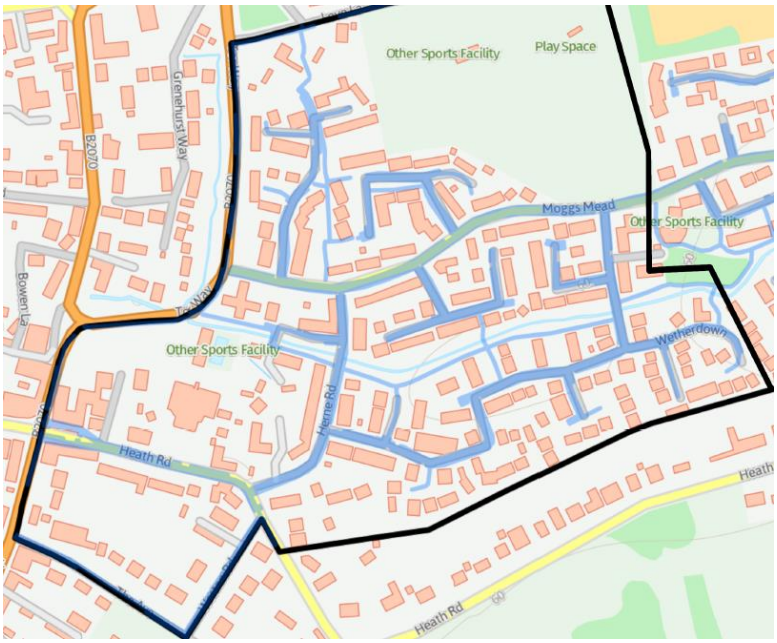
Trial Area 4 - Glyphosate

[Fig. 10]



Trial Area 5 – Acetic Acid

[Fig. 11]

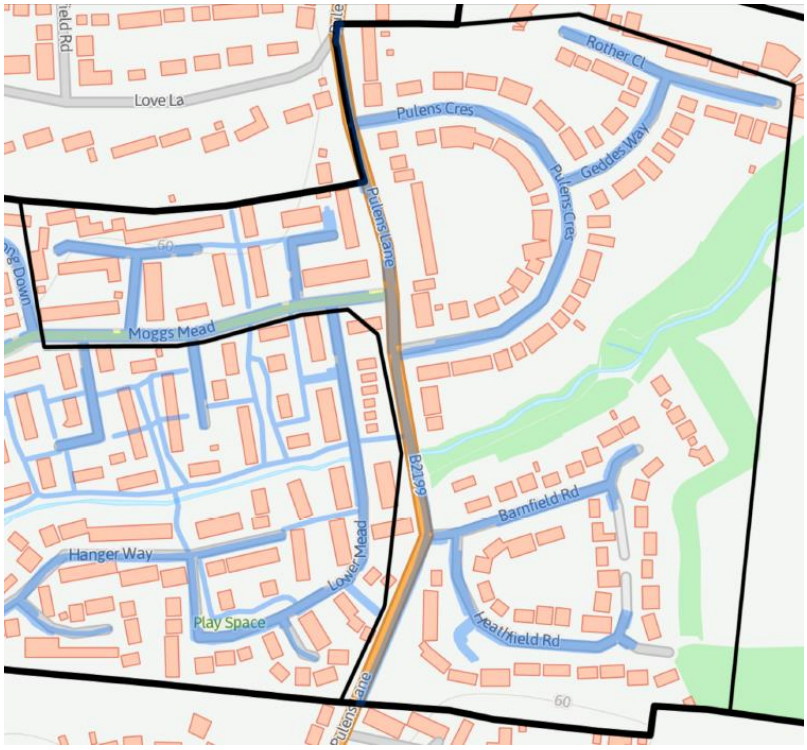


Trial Area 6 – Hot Foam

[Fig. 12]

Trial Area 7 - Control

[Fig. 13]



The Trials:

Area 1 – Integrated Approach

This trial area was slightly larger than the others, totaling a linear km of footway of approximately 7.49km. The initial sweep was delayed slightly from the optimum timeframe as advised by the supplier in March/April but went ahead w/c Tuesday 3rd May. The follow-up weed burn went ahead as planned w/c 23rd May.

The operatives found that the machine was easy to use, but due to the positioning of the brush head, it was limited as to the areas into which it could reach. They were unable to maneuver the machine up close to corner sections, and around street furniture (fig. 14b-14d) and in kerbs where cars were parked. However, where they had a linear run with few obstacles, the machine worked well. One operative reported that the positioning of the trigger handle made the machine uncomfortable to use for prolonged periods, and this would need to be addressed for future implementations due to the risk of strain injury. Operatives addressed this on site by taking turns and swapping between operating the machine and clearing the waste. The machine used approximately 8 litres of fuel at a total cost of £12.80. The team took 71 operational hours to complete the sweep and clear the waste. The overall waste disposal cost was combined between

this operation and area 3 later in the month and totaled £230.00. Therefore £115.00 will be attributed to the integrated approach.

Due to the nature of operating the machine in the carriageway to sweep the kerbs with a pedestrian operative, this methodology does require traffic management to be in place under NRSWA for the protection of staff. Provision for traffic management is not included in the 71-hour figure above.

The follow up weed burn was then conducted w/c 23rd May as planned. Due to most of the mature weed growth having been previously removed, the growth observed at the time of the burn was small and succulent. This meant that the burn could be conducted safely and effectively and small weeds could be seen wilting as the team progressed. The team were limited, in a similar vein to the sweep, in that they could not access kerb lines where there were parked cars, for fear of the heat having a detrimental effect on private property. They had to be aware of ADSL cables and plastic boxes on garden walls that would easily melt from the heat, and were wary of litter, detritus and fly tipping which could catch alight. Overall, the burn on Area 1 was completed in 20 operational hours and used 8 x 5kg cannisters of propane gas at a cost of £280.00. Pedestrian marshals were also in place to warn and divert members of the public, and this is not included in the operational hours figure above, or costs below.

Total operational hours for method: 91

Total area covered: 7.49km

Total cost of consumables (Waste, Propane, Fuel): £407.80

Fig. 14 [a, b, c, d]

Fig. 14a

Weed brush in action

Fig. 14b

Limitation - Outer extermities of machine hitting wall and obstructing operation

Fig. 14c

Limitation - Parked car obstructing both kerb and footpath

Fig. 14d

Limitation - Street furniture around which brushes can't reach

Area 2 – Weed Burn Only

The team found the RIPAGREEN weed burners comfortable to use and covered ground quickly. The propane canisters lasted approximately 2 hours. Area 2 had not been previously swept and so weed growth was much more prevalent in this area at the time of treatment and there was also a lot more detritus such as leaf litter built up in the kerbs. The team had covered 3.93 kilometers in 22 hours using 9 propane cannisters weighing 5 kilograms each*, until management representatives from Milestone Infrastructure and Charlton Environmental visited the site to view the equipment in action. Management observed detritus beginning to catch alight and were not satisfied that this could be continued safely with the level of detritus observed. Therefore, the operation was ended at this point on QHSE grounds as a positive intervention. Figures 15c and 15d below demonstrate the dangers of this scenario. Furthermore, later in the year the country experienced a significant dry spell and drought conditions with many weed grasses drying out completely and leading to further build-up of tinder-like detritus. It is anticipated that given the conditions experienced in July/August 2022, this would be a non-viable approach due to significant safety risk.

**This was comparably slower with more usage per km than the area 1 burn because of the more prevalent weed growth*

Total operational hours for method: 22

Total area covered: 3.93km

Total cost of consumables (propane): £315.00

Fig. 15 [a, b, c, d]

Fig. 15a

RIPAGREEN weed burner

Fig. 15b

Propane Cannister

Fig. 15c

Detritus catching alight

Fig. 15d

Detritus catching alight

Area 3 – Sweep only

Similar to the initial sweep conducted on area 1, the team found the machine easy to use where there were linear unobstructed pavements, but the maneuverability around street furniture and parked cars led to a less than desirable result and operator fatigue. These can be seen in the photographs below. The team covered 4.96km in a total of 48 operational hours, which is consistent with outputs achieved in area 1. However, on this occasion they wore out the brush heads on the machine, which had to be replaced at a cost of £80.00. Fuel cost was for the area was £9.60.

Total operational hours for method: 48

Total area covered: 4.96km

Total consumable cost (Brush Heads, Fuel, Waste): £204.60

Fig. 16 [a, b, c, d]

Fig. 16a

Effective removal of detritus on straight runs

Fig. 16b

Effective removal of detritus

Fig. 16c

Limitation - Team were wary of damaging cable running up a wall

Fig. 16d

Limitation - Unable to sweep effectively around street furniture

Area 4 – Glyphosate

Controlled Droplet Applicators (CDA) were used to apply glyphosate in area 4 in the exact same manner as is currently used across the Hampshire Highways network. One pedestrian operative was deployed to area 4 which totaled 4.66km and completed the area in 3 operational hours using 2 litres of glyphosate concentrate at a cost of £20.32.
As this is a pedestrian operation and the operative could walk along the footpaths, alleyways and verges without stepping into the carriageway, there was no need for traffic management, and very few obstructions resulting in enhanced overall coverage when compared to some of the other trial methods. The product used carries no COSHH warning symbols on the label and is therefore deemed 'non-hazardous'.

Total operational hours for method: 3

Total area covered: 4.66km

Total consumable cost: £20.32

Fig. 17 [a, b]

Fig. 17a
CDA applicator reaching into kerbs despite parked cars

Fig. 17b
CDA applicator

Area 5 – Acetic Acid

"New Way Weed Spray" was applied as a spray application via a Cooper Peglar CP15-2000 series knapsack sprayer.

This product carries the COSHH warning symbol, "corrosive" and historically stated on the label "Dangerous to bees. To protect bees and pollinating insects do not apply to crop plants when in flower. Do not use where bees are actively foraging. Do not apply when flowering weeds are present." This has now been updated on the latest label version to "Risk to non-target insects or other arthropods"

Operatives reported that the product is highly unpleasant to use due to the overwhelming odor, and therefore requires the use of a respirator in addition to the standard PPE required by the product label.

The team covered 5.57 km in 16 operational hours and used 25 liters of product at a cost of £172.50.

Total operational hours for method: 16

Total area covered: 5.57km

Total consumable cost: £172.50

Area 6 – Hot Foam

On day one of using the foam machine the team attended a training course on how to set up and use the equipment safely. The machine had to be loaded on to a drop side vehicle capable of taking the weight of the machine (400kg + 780L of water + consumables, fuel, and crew).

Once on site the foam machine's diesel generator is started and takes a few minutes to reach temperature. The machine remains on the vehicle and in the carriageway, and therefore requires Traffic Management to be in place, and would need consideration to areas with restricted hours working. Once the diesel boiler is up to temperature, operatives start the petrol pump to bring the foam through to the hand lance.

The working hose length gives 50 meters of working area from the machine. One operative is required to operate the machine, and another operative is required to be responsible for the vehicle and guiding the hose around obstacles/obstructions. Heat resistant gloves must be worn as the hose becomes extremely hot. Once the team have treated the reachable areas within 50 meters, they must pack away the hose and move the vehicle along the carriageway to access the next section of footpath.

The 780L water tank when full gives approximately 65 minutes of working time until empty. This meant that for every 65 minutes of operation, the team had to turn off and re-store the equipment and return to Petersfield depot to re-fill the water. This round trip cost the team 40 minutes each

time, approximately 3 times per shift. Fortunately, Petersfield depot is local to where the trials were being conducted, but this would need consideration if rolling out to the wider network. Perhaps with hydrant permits in place, this process could be alleviated slightly.

Overall, the team enjoyed using the equipment, but only covered 2.12 kilometers during their 31 operational hours on site due to the operational inefficiencies with water and having to move the vehicle regularly.

The team were supplied with 25kg of foam additive, which they used entirely, at a cost of £150.00. They used 10 liters of diesel at a cost of £17.00 and 5 liters of petrol at a cost of £8*. In addition, they used over 7000 liters of clean water.

**These fuel figures do not include fuel for the vehicle*

Total operational hours for method: 31

Total area covered: 2.12 km

Total cost of consumables (Fuel, Foam Additive): £175.00

Fig. 18 [a, b, c, d]

Fig. 18a

Foam machine in action

Fig. 18b

Foam Lance

Fig. 18c

Operatives using Foam

Fig. 18d

Foam Machine

Area 7

Area 7 was left as a control area and audited in line with areas 1-6 to see the effects of doing nothing.

Areas 8 & 9

Areas 8 + 9 were originally allocated but later removed from the trials due to the non-viability of ROOTWAVE and Pelargonic Acid.

Audits:

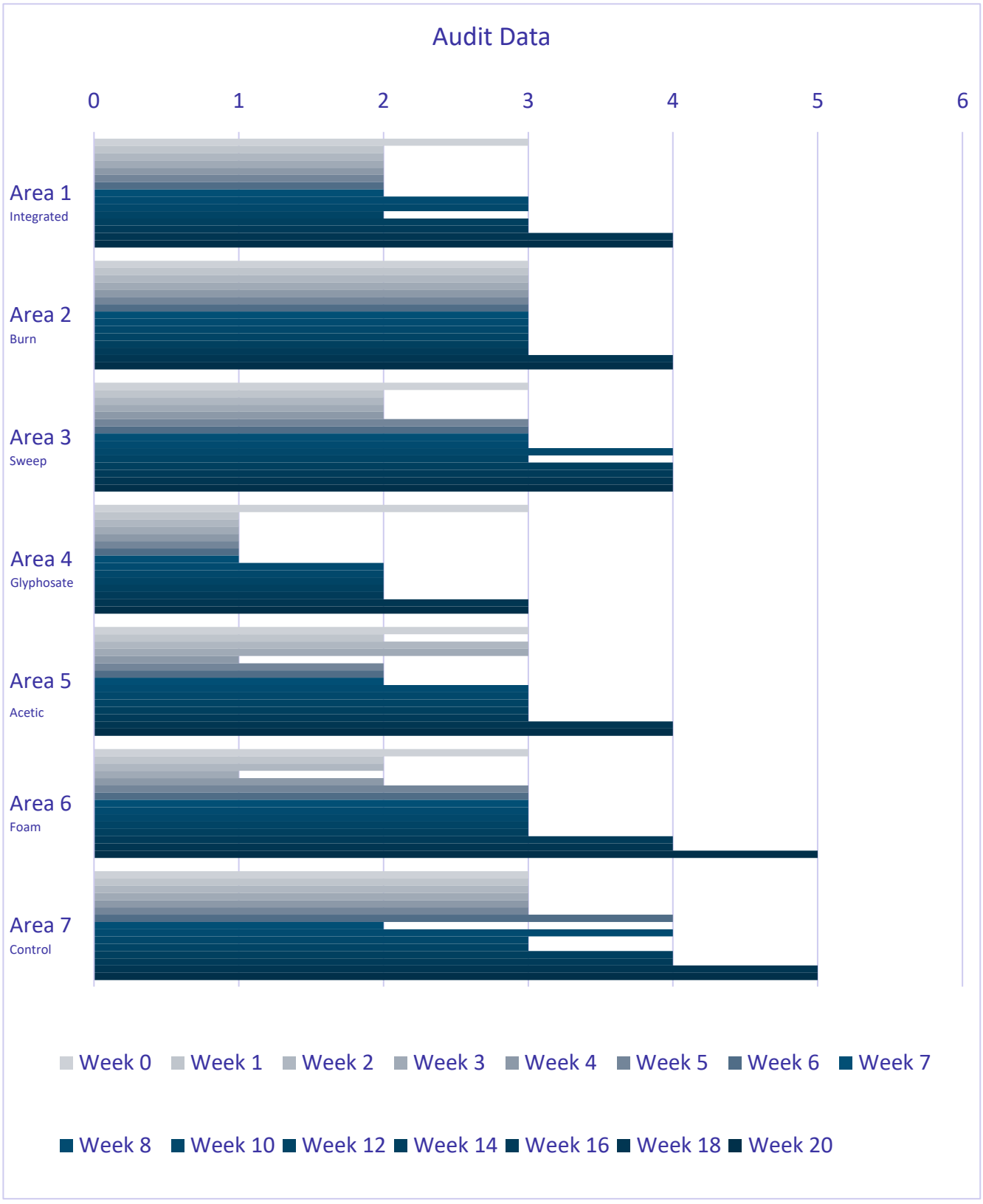
An initial audit was conducted on the first day of the trials (23rd May 2022), at which point all areas were deemed to be at DEFRA level 3. For the integrated approach, the initial audit was conducted on Day 1 of the sweep, and was also deemed DEFRA level 3. This was therefore used at the baseline starting point for monitoring.

Monitoring audits then commenced 1 week following the end of the trials and were conducted once per week thereafter for the first 8 weeks. The purpose of these initial 8 audits was to ascertain the overall short-term effectiveness of each method.

After the 8 initial weekly audits had been conducted, audits changed to fortnightly until the end of October. The purpose of these audits was to ascertain the long-term effectiveness and monitor levels of regrowth in each area.

The data collected is displayed and analysed below.

Fig. 19 [Audit Data]



Area 1 – Integrated Method

The integrated method controlled weeds very well where access could be gained for the sweeping machines, and if full access could have been gained across the area i.e., parking restrictions put in place, then the DEFRA rating could have been further reduced in the short term. The reason that the early audits were only given a rating of 2 and not lower, is because a lot of weed growth remained in difficult access areas, primarily where cars were parked abutting the kerb lines and close to street furniture / obstacles. The lack of detritus in the medium term, due to being removed by the sweep, vastly reduced the seed bed in the area, and therefore the level 2 rating remained in place for 8-10 weeks before re-growth took hold.

Fig. 20 [a, b, c, d]

Fig. 20a

Week 1

Fig. 20b

Week 5

Fig. 20c

Week 10

Fig. 20d

Week 20

Area 2 – Weed burner

Up to the point of being stopped on safety grounds, the weed burners used as a stand-alone method gave mixed results. They worked well on small succulent annual weeds and grasses but had limited effects on established perennials. Over the course of the audits, it became apparent that some larger perennial weeds which initially appeared to have been controlled, had come back to life, either resprouting from the base of the plant (i.e., roots had not been controlled), or even in one case a willowherb had re-grown from the burned and apparent dead matter (fig. 21f). The new growth, however, did seem stunted and not as vigorous as previous growth. This led initially to no significant drop in level of weediness, but re-growth was marginally slower to return than in the control area.

Fig. 21 [a, b, c, d, e, f]

Fig. 21a

Week 1

Fig. 21b

Week 5

Fig. 21c

Week 10

Fig. 21d

Week 20

Fig. 21e

Week 1- Established buddleia not fully controlled

Fig. 21f

Week 3- Willowherb regrowing from burned stem

Area 3 – Sweep only

Much like the integrated method, the sweep gave a high level of control where access could be gained, however parked cars obstructed access to kerb lines and it was not possible to maneuver around some street furniture / obstacles. The audit data shows that there was a significant drop in weediness where the sweep was conducted successfully, however regrowth came back significantly faster than in the integrated method. This is because there was no follow up burn, and so the areas that the sweep could not reach were subsequently not controlled at all, leaving the small annual growth present at the time of the trials to go on to fully establish.

Fig. 22 [a, b, c, d]

Fig. 22a

Week 1

Fig. 22b

Week 5

Fig. 22c

Week 10

Fig. 22d

Week 20

Area 4 – Glyphosate

Glyphosate overall gave the best short and long-term control of both annual and perennial growth. Around street furniture and in kerb lines were controlled effectively due to the maneuverability of the applicator and because this product is translocated within the plants to control the roots, weeds did not come back to life.

Regrowth occurred in line with the other areas, however as there were no uncontrolled areas i.e., no areas that couldn't be accessed or missed weeds. This area remained much tidier and scored much lower on the DEFRA scale throughout.

Fig. 23 [a, b, c, d]

Fig. 23a

Week 1

Fig. 23b

Week 5

Fig. 23c

Week 10

Fig. 23d

Week 20

Area 5 – Acetic Acid

Initially, acetic acid gave a similar level of control to that of the weed burn with varying and mixed results. Small annual weeds and succulent grasses died back, but more established perennial growth was largely unaffected by the treatment. In some cases, again, drawing similarities to the weed burners, larger established weeds were seen to re-grow from the seemingly dead matter, showing that the acetic acid did have some effect, but not enough to fully control the weed.

This led to some anomalies in the data collected, as areas with predominantly grass weeds were successfully controlled: On week 4, we can see the auditor gave a DEFRA rating of 1 (fig. 24f) whereas on week 3, prior to this, the auditor found an area of lesser trefoil which had not been controlled at all and graded the area as a 3. Extrapolating, it seems that the acetic acid provided patchy results, controlling grass weeds effectively, but not performing so well on broad leaved weeds, and particularly established broad-leaved perennials.

Fig. 24 [a, b, c, d, e, f]

Fig. 24a
Week 1

Fig. 24b
Week 5

Fig. 24c
Week 10

Fig. 24d
Week 20

Fig. 24e
Week 3 – Perennial weeds not fully controlled

Fig. 24f
Week 4 – Audit anomaly

Area 6 – Hot Foam

Results from this method could be observed almost instantaneously by the team applying the foam, who reported that they could see broad leaves weeds wilting on site after an hour or two post treatment. Initial audits supported this with the level of control observed on successfully treated areas was one of the best in the trial.

The limitations on maneuverability of the equipment, however, meant that the method overall scored a DEFRA rating of 2 on the initial audits rather than 1, due to inaccessible areas being missed i.e., around parked cars.

Later audits revealed that regrowth in this area seemed to be occurring at a more rapid rate than in other areas, ending ultimately in line with the control area which was left completely untreated. It is evident from analysis of the audits, that most weeds treated with this method completely recovered, meaning that by the end of the season, no significant improvement had been gained by using the method.

Fig. 25 [a, b, c, d]

Fig. 25a

Week 1

Fig. 25b

Week 5

Fig. 25c

Week 10

Fig. 25d

Week 20

Area 7 – Control

The control area was audited in line with the trial areas to ascertain a benchmark level of weediness throughout the audits. In using this benchmark, we can see that all methods used had at least some effect on the level of weed growth, whether in the short or longer term. We can also see how level and species of weed growth changed over time and analyse any effects of "doing nothing."

Fig. 26 [a, b, c, d]

Fig. 26a

Week 1

Fig. 26b

Week 5

Fig. 26c

Week 10

Fig. 26d

Week 20

Outputs:

By using the following formula, we can determine the output per hour for each of the methods:

[Distance Covered (Km) / Time (Operational Hours) = Output Per Hour (Km).

We can also calculate the time required to cover one kilometer of footpath using the following formula:

[Time (Operational Hours) / Distance Covered (Km) = Time Taken to Complete 1Km].

These outputs are displayed in the charts below:

Fig. 27 [Aggregate of Data – Distance & Time]

Area	Trial Method	Distance Covered (Km)	Time (Operative Hours)	Distance Per Hour (Km/H)
Area 1	Integrated	7.49	91	0.082
Area 2	Weed Burner	3.93	22	0.179
Area 3	Mechanical Sweep	4.96	48	0.103
Area 4	Glyphosate Herbicide	4.66	3	1.553
Area 5	Acetic Acid	5.57	16	0.348
Area 6	Hot Foam	2.12	31	0.068

Fig. 28 [Each Method in km/h]

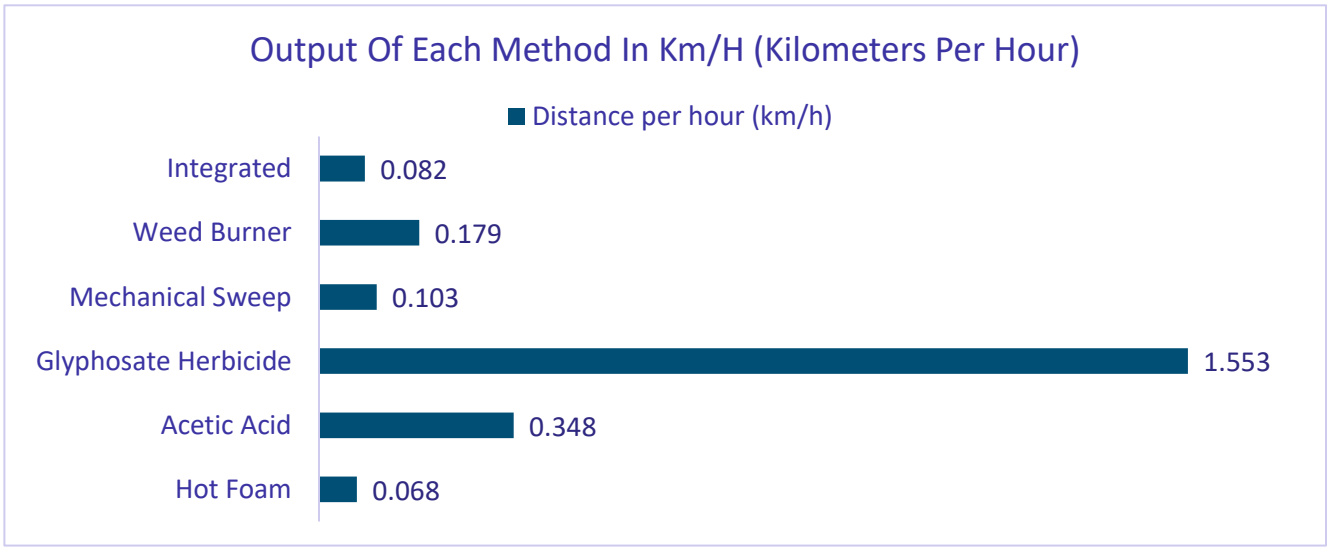
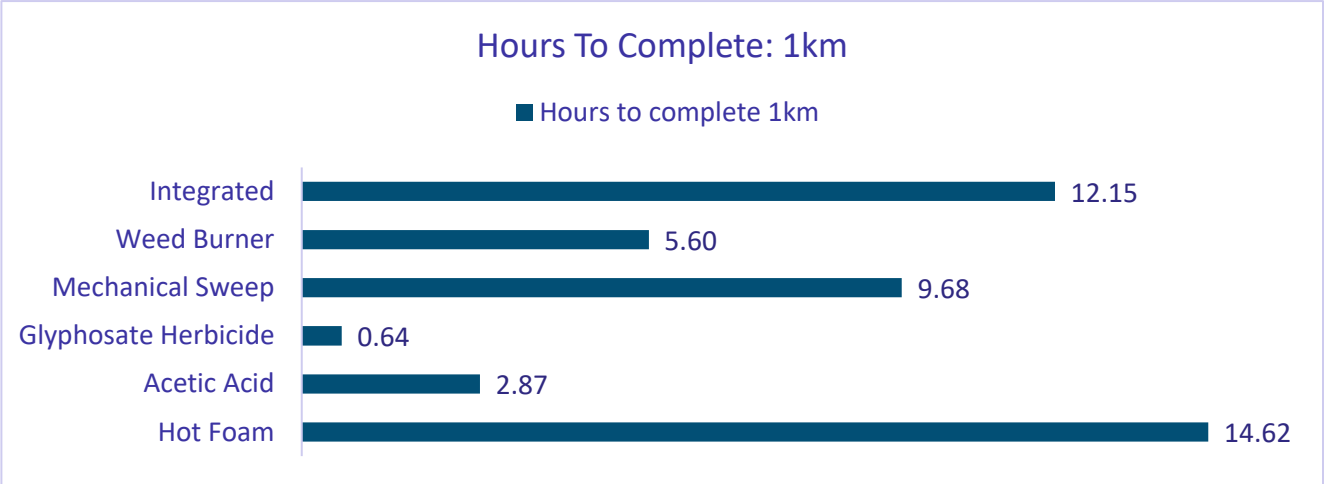
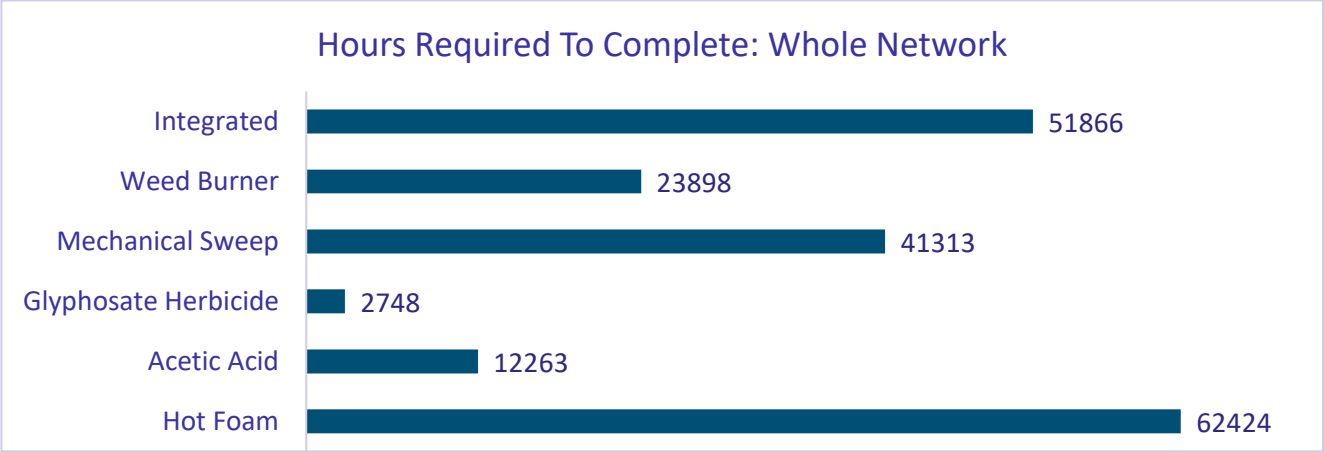


Fig. 29 [Each Method in "Hours To Complete: 1km"]



Drawing from the above output data, by simply multiplying the hours required per km, by the total highways' asset requiring treatment, we can ascertain how many operational hours would be required to complete the Hampshire Highways network as per the current contract including Winchester, Test Valley, Fareham, East Hampshire and Rushmoor. These total to 4269Km of footway to treat annually. These values are displayed below:

Fig. 30 [Each Method in "Hours To Complete: Whole Network"]



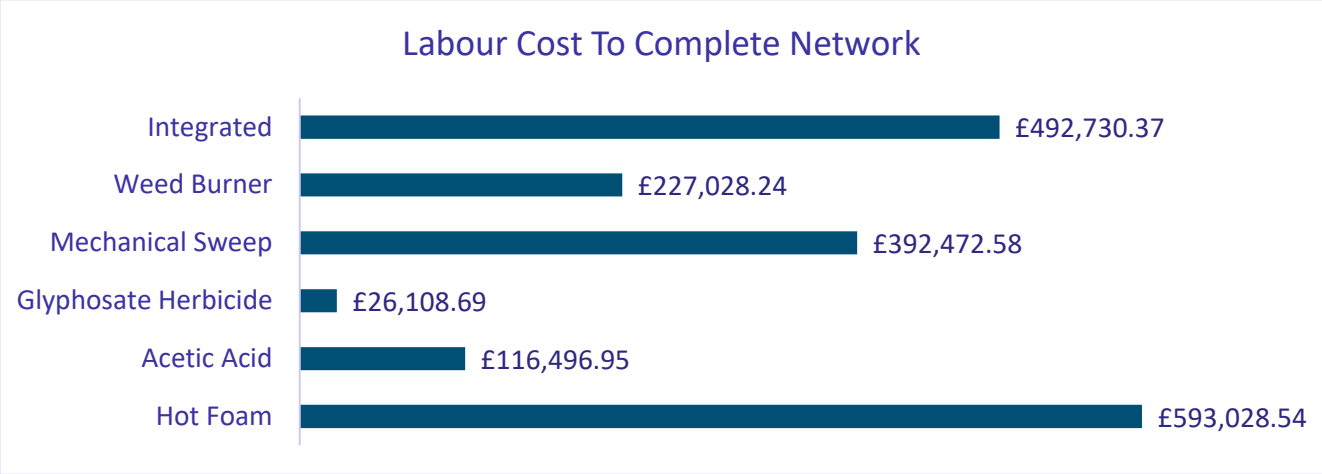
Costs:

Labour Costs

For the purpose of this exercise, we will apply the national living wage as the benchmark labour cost, which when multiplied with the required hours above, will give us a comparable labour cost to complete the network. Further below we will then calculate and add in the consumable cost per

Km, which will give us an overall cost for comparison to complete the 4269Km of highway network per each method. The national living wage at the time of writing is £9.50 per hour.

Fig. 31 [Labour Cost To Complete Network]



Cost of consumables

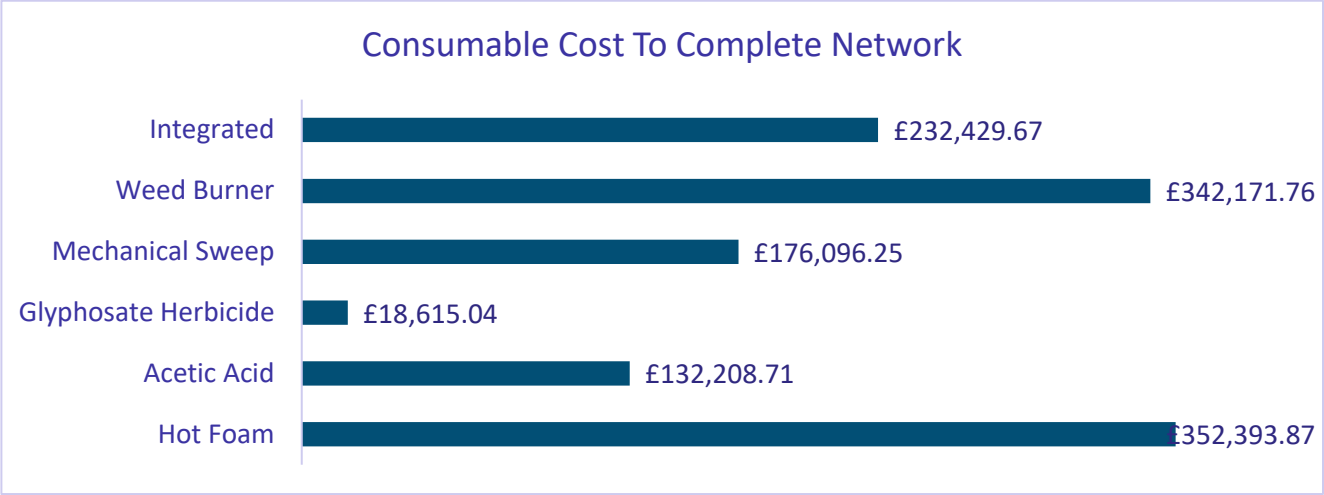
To calculate the cost of consumables for the entire network, the following formula has been used:

[Cost Of Consumable Items / Km Covered During Trial x 4269Km]

Fig. 32 [Aggregate of Data: Costs]

Area	Trial Method	Distance Covered	Cost Of Consumables	Consumable Cost Per Km	Consumable Cost For Whole Network
Area 1	Integrated	7.49	407.8	£54.45	£232,429.67
Area 2	Weed Burner	3.93	315	£80.15	£342,171.76
Area 3	Mechanical Sweep	4.96	204.6	£41.25	£176,096.25
Area 4	Glyphosate Herbicide	4.66	20.32	£4.36	£18,615.04
Area 5	Acetic Acid	5.57	172.5	£30.97	£132,208.71
Area 6	Hot Foam	2.12	175	£82.55	£352,393.87
Area 7	Do Nothing	0	0	£0.00	£0.00

Fig. 33 [Consumable Cost To Complete Network]



Total Costs

By adding the above cost of consumables and the cost of labour together we can estimate the total cost of undertaking each of the methods per km, and on the entire Hampshire Highways network as a whole. It's important to note that these costs do not include any overheads such as vehicle costs, vehicle fuel, PPE, equipment, back-office support etc.

Fig 33. [Total Cost: 1km]

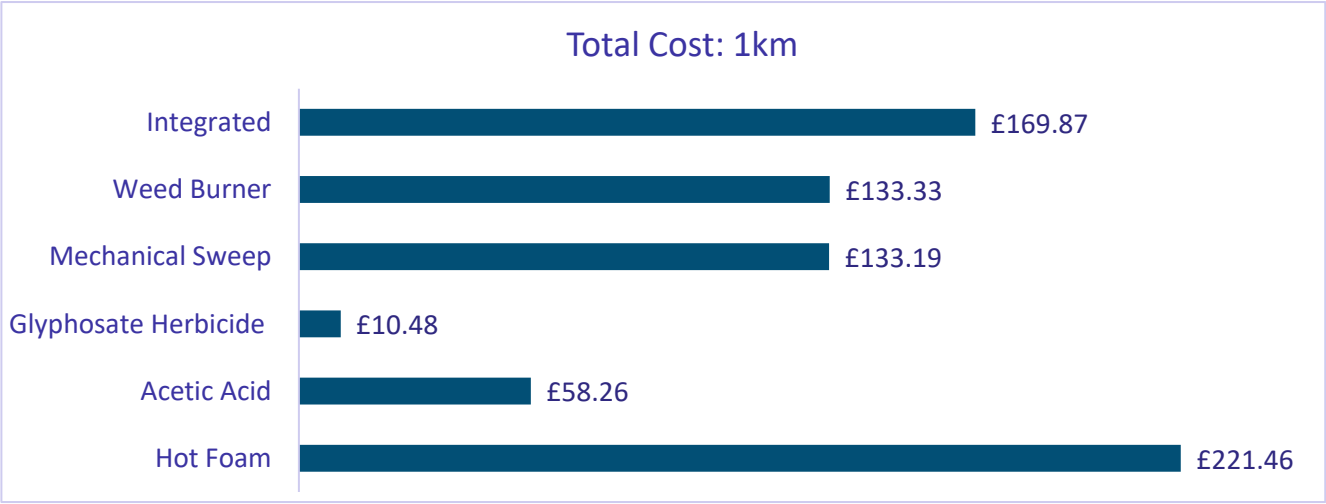
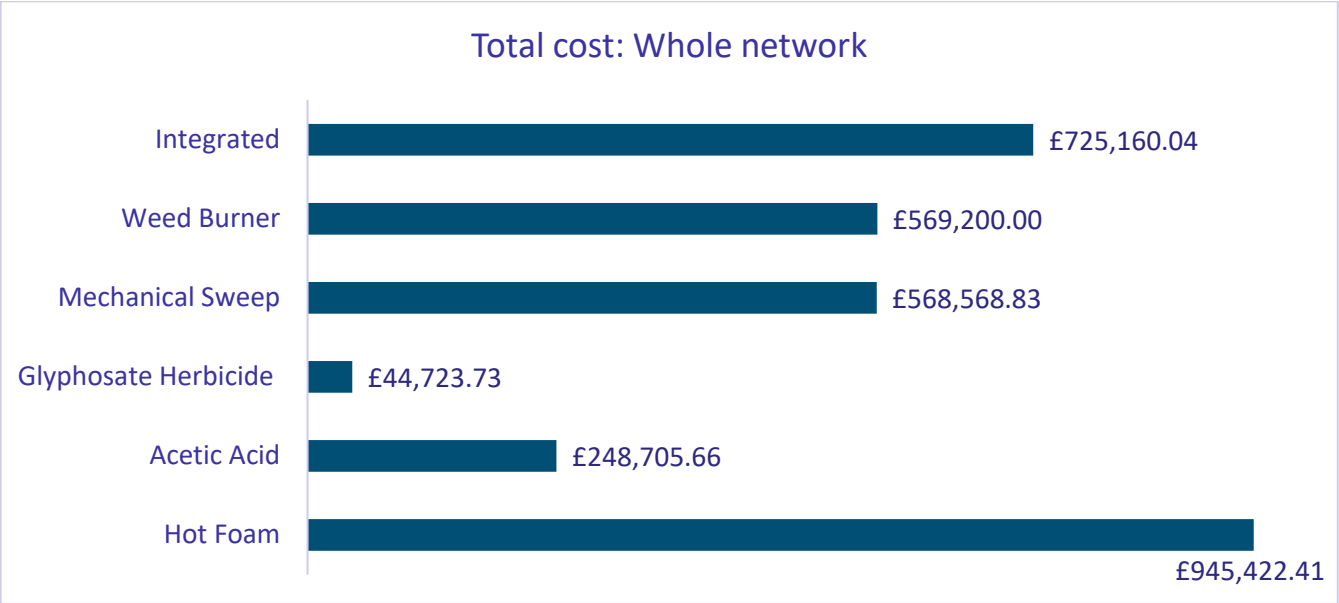


Fig 34. [Total Cost: Whole network]



Conclusions and Considerations:

Despite significant increases in glyphosate herbicide in 2022, this method was the most cost effective and gave the best overall long-term control of footpath weeds within the trial areas.

Acetic Acid remains approximately 5 times more expensive than glyphosate in terms of overall cost and is the next cost-effective method after glyphosate. However, this method did not give satisfactory control of all weed growth.

In both areas which were swept (integrated and mechanical sweep), we observed good long-term control of weeds through significantly reduced levels of regrowth where the machine was able to access due to the seed bed being removed.

Weed burners were deemed unsafe to use in this environment and so are a non-viable alternative.

Whilst the hot foam showed good short-term effects, it had little long-term effect, meaning that multiple visits would be required to give the same level of control. The manufacturer recommends 3 visits per year. However, due to the slow output of this method, this is also vastly more expensive.

With the concerns around weed burners raised within the trial, and the concerns surrounding glyphosate which are main purpose of the trial, an integrated approach combining a mechanical sweep and then a follow up glyphosate spray could give a significant overall reduction in pesticide use.

It is important to consider that the more labour-intensive methods will in turn accumulate greater cost of overheads. For example, the more shifts required to complete the network, the more

vehicles will be required, and more trips to site. In addition, more PPE, equipment, management, etc. will be needed.

Some methods, particularly the hot foam and mechanical sweeping, in addition to the above labour costs, will require traffic management to be in place due to the need to work within or partially block the carriageway whilst works are conducted.

The Sustainable Use Directive 2012 establishes a framework to achieve sustainable use of pesticides by reducing the risks and impacts of their use on human health and the environment. The directive promotes the reduction in requirement for pesticides as far as is reasonably practical with many methods potentially aiding in this. These methods can include building surfaces less susceptible to weed growth and ensuring joints are filled and sealed, public engagement and initiatives, regular street sweeping/cleaning to remove detritus and ensuring to coordinate this with any subsequent herbicide application. These methods should be considered in future planning across the highway network.

The council will determine from the above evaluation, which of the methods trialed meet the needs of their stakeholders and constituents. It may be determined that one method is suitable or remains suitable to treat the network, or another possibility is that certain areas could be targeted in future with alternative methods now that we have established and understand how these methods can be applied and their associated costs

Appendix:

i. IARC Monographs:

   https://monographs.iarc.who.int/list-of-classifications

ii. Pesticide Action Network UK:

   https://www.pan-uk.org/glyphosate/

iii. Oxford Economics:

   https://www.oxfordeconomics.com/recent-releases/The-impact-of-a-glyphosate-ban-on-the-UK-economy

iv. Amenity glyphosate product label:

   https://www.environmentalscience.bayer.co.uk/-/media/prfunitedkingdom/product-msds/monsanto-amenity-glyphosate-xl.ashx?la=en-gb

v. New Way Weed Spray:

   https://www.headlandamenity.com/new-way-weedspray-pesticide-5l

vi. Katoun Gold (Pelargonic Acid):

https://belchim.co.uk/products/katoun-gold/

vii. Foamstream by Weedingtech

https://www.weedingtech.com/weed-moss-control/

viii. Kersten weed brushes:

https://kerstenuk.com/all-products/weedo-ii

ix. Kersten RIPAGREEN:

https://kerstenuk.com/stock-items/wholegoods/miscellaneous-wholegoods/ripagreen-mobility-kit-with-thermal-lance-and-backpack-m0bui

https://kerstenuk.com/files/Ripagreen-Catalogue.pdf

x. DEFRA best practice guidance (withdrawn):

https://www.emr.ac.uk/wp-content/uploads/2015/03/BPWeeds2015web1.pdf