



Pilot Project Results Report

Project Name: Electrifying Small Equipment - Parks 2023

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Contents

Background	2
Pilot Overview	2
Evaluation Overview and Objectives	3
Methodology	3
Key Findings	3
Limitations of Results	5
Recommendation	6
Conclusion	6
Appendix	7
1) Results Summary Table for Line Trimmers	7
2) Comparative Testing for Line Trimmers 2023	9

Background

In 2022, a pilot project was conducted to test the viability of small handheld battery powered equipment with crews from Parks Maintenance and Roads and Parking Services. The pilot was a success, but due to severe weather events and subsequent cleanup efforts, it was delayed, limiting the results.

One of the main recommendations of the 2022 Pilot was to continue testing the equipment from the early spring to the end of the fall to capture data from all growing seasons. The additional testing time would allow for a more in-depth analysis of the equipment's performance and hopefully the ability to measure any impacts to service delays using this equipment may cause.

To better facilitate the different demands of Parks and Roads crews we decided to split the 2023 Pilot between the two areas. This report is focused on the results of the Parks Maintenance crews only.

Brand specific details have been removed for confidentiality reasons.

Pilot Overview

This pilot tested charging stations and the same equipment types as the 2022 Pilot, with a few additions. Line trimmers, handheld leaf blowers, hedge trimmers, small pruning chainsaws and then 1 backpack leaf blower, telescopic pole saws and a push mower.

Another change to this year's pilot was the brands involved. The results from 2022 revealed that Brand 4 equipment did not perform to the required maintenance standards of the Public Works Department (PWD) and so it was replaced with a new line of equipment from a new brand.

Brand 3 equipment, which was tested via free trial, was returned to the vendor and not brought back due to average performance. The Brands 1 and 2 tested well and were used again.

Similar to the 2022 pilot, the equipment was tested by travelling crews that operated out of Bloomfield, Iber and Trim facilities since the charging infrastructure was already in place. To expand this pilot two additional crews were added, one at Britannia and one at Mooney's Bay. These are both considered Destination Parks and feature onsite charging/storage locations which removes the need to transport large amounts of batteries in the crew vehicles. Instead, dead batteries can be brought back to the on-site maintenance buildings for charging throughout the workday.

Crews began using the equipment in May and continued until late September 2023.

Evaluation Overview and Objectives

- 1) The Pilot intended to determine if the available commercial battery powered equipment on the market is a suitable replacement (able to meet maintenance standards) for the gas-powered equipment currently being used by Parks Maintenance Services
- 2) The Pilot intended to determine if the equipment performance significantly varied during the different growing conditions of Spring, Summer, Fall.
- 3) The Pilot intended to measure any potential delays that may occur from using battery powered equipment compared to gas-powered alternatives.

Methodology

1. **Daily Survey** to be completed by all crew members at the end of each work day to capture data related to power of the equipment and general useability (ergonomic rating of weight, balance, vibration, and comfort) for each type of equipment and noted the conditions (weather, length of grass, thickness of branches etc.) they were used while crews completed their work to the current maintenance standards.
2. **Tailgate Meetings** and crew leader feedback were also used to capture any damage, repair/maintenance needs or feedback not identified in the surveys.
3. **Battery Run Time Log** to be updated every time a battery was depleted or a work task was finished. Staff would note the approximate runtime in minutes, the equipment type, brand, task, and conditions.
4. **Comparative Testing** for Line Trimmers to be conducted near the beginning and end of the pilot. A controlled test to measure the time to cut a designated area with all battery line trimmers and a Gas-powered Line trimmer to determine if there will be any delays caused from the use of the battery powered equipment, particularly in heavy/wet growth conditions. See appendix 3 for more details.

Key Findings

Below is a summary of findings based on user feedback surveys, tailgate meetings, crew leader recommendations and the two Comparative Test days.

Line Trimmers

Results show most brands of line trimmers perform well compared to gas powered units when trimming thick, dense grass and weeds with only slightly more time required to perform the same task. Test conditions exceeded what a crew would trim during a typical workday.

Brand 1 and Brand 5 performed the best in the Comparative Tests, Brand 2 and Brand 3 were the slowest.

Changes in growth conditions had only a slight impact on battery life, with the heavy spring growth depleting batteries quicker but not enough to cause issues.

Tailgate feedback and survey data documents issues with Brand 5 equipment late in the summer. Run times decreased and several durability issues were noted. Trimmer heads wore out after only 2-3 months of use compared to other brands lasting well over a full trimming season. Re-loading trimmer heads also caused delays and frustration. The guard on the line trimmer head was also noted to be too small to effectively stop debris from hitting the operator. Staff adamant we do not choose Brand 5 for wide scale adoption.

Recommendation: battery powered line trimmers are suitable for Parks Maintenance needs and will not cause any significant delays for crews compared to using gas powered trimmers. Results will be shared with other City departments to support any potential transition plans.

Brand 1 has overall performed the best in battery runtimes, general performance and received the most favorable feedback from staff. 1 battery will provide approximately 1 hour of use during a typical workday.

Blowers

Battery handheld blowers are great for quick clean ups or light/dry debris due to convenience of no gas/fumes and no need to pull start machine.

Battery Life is the main issue across all brands. 1 battery lasts about 20-25 minutes of continuous use, which is not suitable for large cleanups. Lack of power was also noted as an issue when clearing heavy or wet debris.

Brand 1 Backpack Blower provided enough power to clear heavier debris from beach pathways at Britannia Park during a 1-week trial. This unit does require a larger, heavier battery which connects to the backpack and provides increased power and longer run-time compared to the handheld blowers. This battery is not compatible with other Brand 1 equipment. Test time was limited but run-times exceeded 1 hr.

Recommendation: wide scale use of battery powered handheld blowers is not recommended at this time but crews that fit the recommended uses could be equipped with a battery blower. Transition should be done on a case-by-case basis.

Hedge Trimmer, Pruning Chainsaw, Pole Saw, Push Mower

Note: Limited data is available for these equipment types as they are not used every day or for long periods of time.

All feedback from surveys and tailgates was positive across all brands tested in 2023.

No battery life or power concerns noted when performing typical tasks for Parks crews. Several crews noted that they preferred the battery versions of the hedge trimmer, pruning chainsaw and pole saw since the performance was excellent and there were no exhaust fumes in their face, less vibration and no need to pull start machines. They would gladly make the switch permanent.

Only 1 Push Mower (Brand 1) was tested during this pilot, used exclusively at Britannia Park. The crew noted it was quieter, lighter, and easier to push than a gas mower. It has capacity for two batteries, to be swapped when one dies, runtime of approx. 1 hour for each battery.

Note: Britannia crew used Brand 1 equipment and requested to keep all battery equipment as they preferred it to gas equipment.

Recommendation: Battery powered Hedge Trimmers, Pruning Chainsaws, Pole Saws and Push Mowers are a suitable replacement for gas powered equipment for the needs of the Parks maintenance and likely most of PWD where this equipment is used for short periods of time.

Limitations of Results

The durability and lifecycle of battery powered equipment and batteries remains unknown.

Based on discussions with operational staff, including Small Equipment Technicians (SETs), the current gas-powered equipment can be easily maintained in house and most parts needed for repairs are readily available. For example, some gas-powered line trimmers can be kept operational for upwards of 10 years.

The same cannot be said for battery powered equipment since it has only been operational for 2 years now and our SETs have limited experience with the equipment. Staff do not have enough experience with battery powered equipment to understand how long the equipment/batteries will last.

Concerns of slow service from vendors to obtain replacement parts and the ability to make repairs in house have been raised. So far, 2 Brand 4 batteries have failed; 1 found on a charger June 13th, 2023, the other was found during the comparative test day on Sept 27th, 2023. Both remain with the vendor waiting for the manufacturer to address the issue.

There was a 4-month delay to receive parts to replace a broken trigger for 1 Brand 1 line trimmer. The repair was done in house once the parts were available.

Brand 2 line trimmer heads purchased in 2022 needed replacing by mid-summer 2023. This is a similar lifecycle to gas trimmer heads. The Brand 5 line trimmer heads purchased in 2023 needed replacing within 3 months of use. Parts were not available to do repairs, only new full head replacements could be obtained. Lastly, the Brand 5 line trimmers showed a vibration increase over the 2023 pilot.

At this point in our experience with battery powered equipment it seems it cannot be serviced to the same extent as gas-powered equipment. Replacing motors and trimmer heads seem to be

the only option available right now, indicating it costs more to maintain battery-powered equipment.

Recommendation

- 1- Crews should continue to use the battery powered equipment for their daily tasks and continue to gather feedback with a focus on performance and durability of the equipment and batteries. Any repairs or service issues should be well documented to help determine the lifecycle of the equipment and batteries.
- 2- Monitor the market for any new or improved battery powered equipment with a focus on longer battery life and increased power of the equipment. Any new equipment should be tested via free trials if possible.
- 3- Any future transition plans should follow a strategic approach based on crew specific needs and to ensure batteries are compatible with equipment purchased. Planning should not begin until the completion of the RCFS electrical capacity review and the plan for Fleet electrification.
- 4- Brand 1 equipment has generally performed the best in the 2 years of piloting followed by Brand 2. These brands are also the most frequently used brands in the gas-powered inventory and therefore make the most logical choice when transition begins.

Conclusion

This pilot project showed that, in general, the small handheld battery-powered equipment types tested are a suitable replacement for the current gas-powered equivalents used in the Parks Maintenance. Depending on the brand chosen, Line Trimmers performed very well and there were no significant performance issues related to use of the equipment in different seasonal growth conditions and the use of this equipment will not cause any significant delays for staff as they complete their work to the current maintenance standards. Leaf Blowers, Hedge Trimmers, Pruning Chainsaws, Pole Saws and Push Mowers are also suitable replacements for gas powered equipment where it is used for short periods of time. Service areas such as Forestry or Roads that have more demanding needs from specific equipment types will have to make equipment specific transition plans on a case-by-case basis.

The key benefits of battery powered equipment are the lack of fumes, exhaust, and the need to pull start the engines which can all be health and safety risks to City staff. Adoption of battery powered equipment will depend on the ability to safely charge enough batteries for crews to complete their daily work. The charging demand of batteries may decrease as improvements in battery technology occur. More information is required before consideration can be given to a widespread conversion. There is currently a review underway to understand facility electrical load capacity and electrical requirements as small equipment conversion is only one piece of the larger scale discussion.

Appendix

1) Results Summary Table for Line Trimmers

	Brand 2		Brand 1	Brand 5		
	Spring (May to June 21)	Summer (After June 21)	No noticeable change across season	Spring (May to June 21)	Mid Summer (June 21-Aug 15)	late Summer/fall (after Aug 15)
Power rating 1-5:	4	5	4	4.2	4 (note crew change)	4
Battery Life 1-5:	3.4	4	4	4.4	2.4 (note crew change)	2
Average Runtime in Minutes	36		58	Overall 33	38	28 (note decrease)
Low-High Runtime in Minutes	20-65		35-86	19-70		
Weight:	Excellent		Good	Good	Fair-Good	Good
Balance:	Excellent		Good	Good	Good	Good
Vibration:	Excellent		Excellent	Excellent	Good	Fair (noted decrease)
Comfort:	Excellent		Good	Good	Good	Good
Survey Comments:	<ul style="list-style-type: none"> Power and battery Life issues with thick grass. Using a lot of String and some issues with String jamming. Some Overheating and random stops while cutting thick grass on a clear day. 	<ul style="list-style-type: none"> Less issues with longer grass after spring 	<ul style="list-style-type: none"> No complaints or issues 	<ul style="list-style-type: none"> Complaints about battery life Safety Guard too Small 	<ul style="list-style-type: none"> Using a lot of String battery life unacceptable, Safety guard inadequate and dangerous Restrstringing is a nightmare, Whip string could not be removed, when restringing, took head apart could not get back on. Wasted 90 minutes trying to restring a whip. 	<ul style="list-style-type: none"> String sticking inside, needing to take head apart, multiple times

2) Comparative Testing for Line Trimmers 2023

Background: Based on findings from 2022 pilot we identified that battery powered Line Trimmers can require an extra pass to handle thick or wet grass/weeds but we were unable to quantify the time that would take.

Purpose of Comparative Tests: Given the nature of the crews work environment there are too many factors that might cause delays in completing daily tasks, so it was decided that performing a controlled test could allow us to determine if there is any significant delay as a result of using battery equipment vs gas equipment. This test is designed to capture data that allows us to identify whether additional FTEs or contracted crews are required to meet maintenance quality standards, particularly during heavy growth season.

Date: Test Day 1- June 13th, 2023. Test Day 2 September 27, 2023

Location: Field at Maple Grove

Participants: Tim McGrath and Shawn Norman

Method

- Note conditions: Test Day 1 was overcast after several days of heavy rain. The grass and weeds were between 2-3 feet long and wet during the test period (see appendix 1). Test Day 2 was overcast, grass was slightly longer and denser (see appendix 5) than first test day and the dew was heavier as well. Overall, it was tougher cutting than the first day, and the times reflect that.
- Rope grid of 7, 10m x 10m squares set up for testing (see appendix 2).
- Record time it takes to trim grid with each brand of line trimmer used in pilot and gas trimmer commonly used by Public Works staff.
- All tests completed to the same maintenance standard to maintain equal comparison between the equipment. (See appendix 3).

Materials

- Line Trimmers: Gas- Stihl, Battery – Brands 1,2,3,4,5,6
- Batteries, 2-3 for each piece of equipment
- 15-20 Stakes
- Rope
- Stop watches
- PPE- ear and eye protection, steel toe boots, gloves, Tyvek suits for Wild Parsnip (see appendix 4)

Notes:

- Test day 2 used reverse test order from the first test day to mitigate grass drying impacting the testing conditions. Set up was done in advance so all testing was completed before 10 am which meant the grass remained consistently wet for all tests.
- Did not conduct Stress tests (dropping from tailgate height to test durability) as we felt the equipment would likely break, as would a gas trimmer. Durability should be tracked over the next few years during normal work conditions. This will provide an accurate expectation of how the equipment will age given the rigors of normal working demands.

Results

Brand	Test Day	Batteries Consumed	Time to Finish	Notes
1	1	3/4 of 1	17 min	Broken trigger while still functional made gripping handle more tiresome so frequent hand switching occurred. Felt like the most powerful battery trimmer
	2	1 (12 min) and 1/4	19 min	Cuts great, feels like the strongest battery trimmer. Never gets bogged down or feels like its struggling. This area had some very thick growth and some cat tail reeds but it handled them well.
2	1	1 (25 min) and 3/4	35 min	End of test revealed only 1 string instead of 2. Unsure when the other string came out during testing. This would explain the slower cut time. Power level felt less than Stihl but enough to handle the test area.
	2	1 (21min) and 3/4	39 min	Shorter trimmer than the others, not as comfortable to hold, strap could help. Good power.
5	1	1 (10 min) and 1/4	16 min	AP mode to maximize run time adjusts throttle automatically and would slow down seemingly at random. Takes getting used to but still effective.
	2	1 (11 min) and 1/2	19 min	AP mode is frustrating for user as it will ramp up and down on its own which can be surprising. Cuts very well at full speed.
6	1	1 (17 min) and 1/3	20 min	Excellent power, handled conditions no problem. Best ergonomic feel
	2	1 (16 min) and 2/3	29 min	Great power, gets up to full speed very quickly. Comfortable to use and didn't struggle in heavy grass.
3	1	2 (9 min, 17 min) and 3/4	38 min	Frequent shut offs when cutting due to thick grass. Unit struggled with thicker areas, had to cut using slower repeated passes to avoid shut offs. Lowest power and cheapest feel. Might not be suitable for commercial uses.
	2	2 (14, 19) and 1/2.	39 min*	*Only 3/4 of the plot was cut. Ran out of batteries to finish. Required multiple passes to get a proper cut in heavier grass. Does not feel like it is commercial grade.
4	1	2 (9 min, 10 min) and 1/4	20 min	Grass was notably drier than earlier tests as it was the last test of the day and after a 1 hr. break to wash/return other units and pick up this trimmer.
	2	2 (8, 13)	21min*	*Did not finish entire lot due to battery failure. The first battery failed before being depleted. Unit kept stopping, not under load. Did not cut well, required multiple passes.

Gas Powered Stihl	1	approx. 3/8 of the 24 fl.oz. Tank = 9 fl.oz	18 min	Superior power to all battery units. Noticeably more noise, vibration and heavier to use. More strain on the lower back and forearms/hands.
	2	approx. 1/3 of the 24 fl.oz. Tank = 8 fl.oz	16min	Best Power, no issues with thick grass. Heaviest and most vibration.

Conclusion

Time to finish results reveal that, in general, the battery-powered trimmers cut the same area of dense wet grass as the gas-powered trimmer. These conditions are beyond what a typical workday would involve for most parks and roads crews but it shows that using battery powered trimmers will not cause a significant delay in completing daily tasks. If a switch from gas to battery powered trimmers occurs there won't be a need to add additional staff for crews to perform their beats at the current pace and maintenance quality standards.

Appendix 1: Conditions, long wet grass and weeds between 2-3 feet in length



Appendix 2: 10m x 10m grid was set up using stakes and rope



Appendix 3: Test area after trimming



Appendix 4: PPE used and trimmers lined up for testing (Greenworks not pictured)



Appendix 5: Test Day 2 Conditions long wet grass between 2-3 feet in length, very dense.

