Using ProcellaCOR FX and Reward® at Drag and Spruce Lake, ON: A Literature Review

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1.0 Introduction

1.1 Drag and Spruce Lake Overview

Kasquashibook or Kashquashibioh, meaning "where the waters meet" (DSLPOA, 2026), is part of the traditional lands and waters belonging to the Iroquoian-speaking Mohawk (Kanien'kehá:ka) First Nations and the Ojibwe-speaking Anishinabewaki First Nations (Native Land Digital, 2026).
It was in this territory where seven smaller Ojibwa and Mississauga Nations, including Alderville First Nation, Curve Lake First Nation, and the Chippewas of Christian Island, were subject to the signing of the William's Treaty in 1923, and three large areas of land were relinquished to the Canadian Government (Surtees, 2010). Now named the Drag and Spruce Lakes system, this waterbody is now located in Haliburton County within the township of Dysert et al.

Depending on the season, Drag and Spruce Lakes have an average depth of 17.96 m (max. depth 54.9 m) and an average pH between 7.49-7.77 in the euphotic zone and an average pH of 7.43-7.5 one meter from the bottom (Ministry of the Environment and Climate Change, 2018). Drag and Spruce Lakes are located on the southern most part of the Canadian Shield, meaning they are home to a rich community of terrestrial and aquatic plants who prefer neutral-acidic environments and clear, fresh waters.

Currently, Drag Lake is home to a population of Eurasian watermilfoil (*Myriophyllum spicatum*), or EWM, which make up ≤ 4% of the lake's total surface area. In the past, ecological stewards belonging to the Drag & Spruce Lakes Property Owners Association (DSLPOA) have tried multiple removal methods of EWM, including hand-pulling and benthic matting, in attempts to prevent further spreading of the invasive species. However, in light of the current discourse surrounding aquatic invasives and the negative impact EWM may have on the lake and its shoreline residents, members of the DSLPOA have expressed interest in chemical removal through the use of systemic and/or contact aquatic herbicides currently registered for use in Canada.

1.2 The Purpose of this Project & Intended Outcomes

The goal of this project is to provide context surrounding the only aquatic herbicides currently allowed for use in Ontario, ProcellaCOR FX and Reward®, in preparation for future management of EWM populations at Drag and Spruce Lakes. This report will act as a review of both herbicides, including chemical labels, safety data sheets, scientific and peer reviewed literature, to help explain the mode of action and behaviour in the environment. It is important to note that Reward® will not be as thoroughly investigated in this report as ProcellaCOR FX, because Reward® is not the recommended course of action for Drag and Spruce Lakes, which will be explained further in the discussion (section 5). Regulatory procedures along with primary accounts from another lake association, the Farlain Lake Association, are also provided. The possible implications of these findings on Drag and Spruce Lakes and any further considerations to be made by the DSLPOA will be included so that members may feel knowledgeable enough to make a decision on whether or not the DSLPOA should choose to apply a chemical treatment in managing their EWM population. The end of this report includes final conclusions and recommendations for the future based on the information provided throughout the report.

2.0 Aquatic Herbicide Overview

2.1 ProcellaCOR FX

2.1.1 Regulatory History

ProcellaCOR FX is currently registered under several different names by the Pest Management Regulatory Agency (PMRA). These include: Rinskor Active, Milestone NXT Herbicide, Restore NXT Herbicide, GF-3206 Herbicide, GF-3301 Aquatic Herbicide, and finally ProcellaCOR FX/EC Herbicide (Government of Canada, 2023). An application for the request for approval of the active ingredient Florpyrauxifen-benzyl (FPB) was sent on January 30, 2023 to Health Canada, and was approved and registered by the PMRA in May of the same year (Government of Canada, 2023). FPB has been registered in the United States since 2018, and is allowed in all states except for Alaska (SePRO, 2026), after it was judged non-hazardous under the Federal Occupational Safety and Health Administration (OSHA) Hazard Communication Standard (US EPA, 2018; OSHA, 2026). The Health Canada approval process was in accordance with the Pest Control Products Act, which requires all pesticides used in Canada to first undergo authorization of overall safety, which includes analysis of effects on health and environment. Following this analysis, as indicated in Section 28 of the Pest Control Products Act, is a public inquiry, which allows members of the public to bring forward any concerns regarding the decision for a duration of time (Government of Canada, 2023).

2.1.2 Classification

ProcellaCOR FX is considered a Group 4 herbicide, meaning it is a synthetic auxin (SePRO, 2025) and absorbed through the shoots and leaves of EWM, among other macrophytes. The specific mode of action is further explained later on in this report. ProcellaCOR FX is classified as a systemic, selective herbicide, meaning that it is designed to kill the entirety of specific targeted freshwater plants (SePRO, 2026). These targets include **hydrilla, all milfoils, crested floating heart, and others** (for full list of target plants, see Appendix I, Table A). ProcellaCOR FX is marketed as an effective aquatic herbicide that requires 40-100x less of the active ingredient in comparison to other herbicides (SePRO, 2026) and is to be used in lentic bodies of water with minimal to no continuous outflow, such as "ponds, lakes, reservoirs, freshwater marshes, wetlands, bayous, drainage ditches, non-irrigation canals, shoreline/riparian areas, coves, oxbows, etc" (SePRO, 2025). However, the ProcellaCOR EC safety data sheet warns that any accidental spills of ProcellaCOR in "natural" aquatic systems (i.e. ditches, waterways, groundwater, etc) may increase the risk of aquatic organism mortality along with the contamination of soils as the spilled amount may exceed the recommended dose (SePRO, 2017).

2.1.3 Active Ingredient: Florpyrauxifen-benzyl

The active ingredient in ProcellaCOR FX is a chemical named florpyrauxifen-benzyl (FPB) (Figure 1), and this is the ingredient that causes the most damage to the targeted plant. This particular chemical was created by Dow AgroSciences in early 2018 (US EPA, 2018) and is the main ingredient in ProcellaCOR (SePRO, 2025). Less than a year after its development, FPB was also approved and registered in the USA (SePRO, 2026).

Chemical Profile

FPB is considered a benzyl ester, due to its combined florpyrauxifen carboxyl group (–COOH) with a benzyl alcohol ($C_6H_5CH_2OH$) hydroxyl group (–OH) (National Center for Biotechnology Information, 2026a). Most importantly, the chemical consists of aromatic rings (the hydroxyl group of a benzyl alcohol), or the closed hexagonal shapes that can be seen in the chemical structure (Figure 1). Chemical structures with benzene ring compositions are often very durable (Crimmin, 2021), which may explain florpyrauxifen-benzyl's failure to pass the OECD test 10-day window guidelines, a standardized test that measures organic chemicals' ability to degrade in the environment within a 10-day and/or 28-day study period (Lemco, 2025). A chemical will fail if ≥ 60% does not transform into CO_2 before the end of the study period (Lemco, 2025). In the case of FPB, it only degraded 14.6% over 29 days, which means it is very slow to break down (SePRO, 2017).

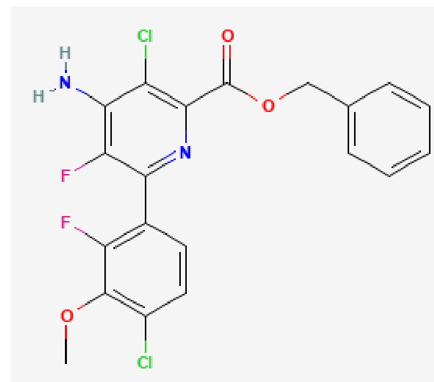

Figure 1. Chemical structure of ProcellaCOR FXs active ingredient Florpyrauxifen-benzyl (chemical formula: $C_{20}H_{14}Cl_2F_2N_2O_3$). (National Center for Biotechnology Information, 2026a)

Mode of Action

This chemical is a synthetic auxin, or a growth inhibitor, which can best be described through a key and lock system. Most plants have full hormone receptors, or locks, which require specific phytohormones/ plant growth regulators (PGRs), or keys, to trigger the release of chemicals to initiate different actions, such as root and stem growth. However, a synthetic auxin will mimic the look of a plant's regular "key" and take up space by inserting itself in a "lock", preventing any of the plant's natural keys from binding to its normal designated lock. This inability of the plant to use blocked locks can prevent growth or other hormonal responses. In the case of FPB, it blocks the binding receptors responsible for regulating the elongation of plant cells, causing dysregulation and excessive growth, which ultimately kills the entire plant by causing structural and vascular failure, and eventual starvation (Wisconsin Department of Natural Resources, 2022; Ashton & Crafts, 1973).

FPB can enter the plant's shoots and leaves through the process of "phloem trapping", as theorized by Bromilow et al (1990) and further touched upon by Epp et al. (2016). The process of phloem trapping, where xenobiotics with higher n-octanol/water coefficients (with a higher affinity for lipids) enter a plant through its lipophilic phloem wall and further ionize, allows for easy movement throughout the plant. This movement happens due to the lipid-soluble nature of FPB's carboxy group (Bromilow et al., 1990; Epp et al., 2016; Haug et al., 2012).

2.1.4 Environmental Hazards Based on the SDS

ProcellaCOR FX's environmental hazards include restrictions on the disposal of the dead plant matter. It is not recommended to compost the dead plants, likely due to risk of contamination of soils made of the composted material, which would still contain FPB. Although some laboratory studies indicate excessive decomposing plant matter and the presence of oxygen-consuming bacteria can lead to oxygen depletion and therefore fish suffocation, this is only relevant for nutrient enriched lakes, and will therefore be an unlikely issue for Drag Lake (SePRO, 2025).

When measuring the toxicity of a substance in organisms, different parameters are used, including tests such as Lethal Concentration 50 (LC50s), and Effective Concentration 50 (EC50s). LC50s indicate when 50% mortality is reached in a test population, and EC50s indicate when 50% nonlethal but debilitating effects are seen in a test population (Little Pro, 2016a). ProcellaCOR FX is considered an acute toxin to fish and aquatic invertebrates. Toxicity studies on Carp show an LC50 > 100 mg/L and an EC50 (96 h static test) >120 mg/L, and studies done on the Waterfleas (*Daphnia sp.*) depict an LC50 10-50 mg/L and an EC50 (48 hr test) 49 mg/L (SePRO, 2017). For context, it is recommended that in areas with an invasive macrophyte population of >2-10%, like Drag Lake, EWM should be treated with 6.4-9.6 fl. oz per acre-foot of water of ProcellaCOR FX (or 0.0104-0.0156 lb of FPB) (see Appendix, Table D for full dose list of recommendations) (SePRO, 2025). This would equate to ~ 0.23 mg/L of ProcellaCOR FX entering an aquatic system per treatment. The Carp and Waterfleas would not be at risk after one treatment. Prescription Dose Units are fully explained in Section 3.1.2.

Other tests that specifically measure the toxicity of a substance on plant material or organisms include Effect Concentration 50% growth rate (ErC50s) and No Observed Effect Concentration (NOECs). ErC50s indicate when 50% of a test plant population stops growing, and NOECs identify the maximum contaminant an organism can withstand before (sub)lethal effects (Little Pro, 2019). In ErC50 and NOEC studies done on EWM, it was found that after 14 days, 0.000919 mg/L halted growth in half of the test population, while 0.0000954 mg/L caused no effect (SePRO, 2017). Based on the calculation above (~ 0.23 mg/L of ProcellaCOR FX), there would be a toxic effect on EWM after one treatment.

According to the ProcellaCOR safety data sheet, there is no available data on the n-octanol coefficient (SePRO, 2017). The n-octanol/water coefficient (log Pow) measures the likelihood of a substance partitioning to an organism's fatty (octanol) tissues or water (Little Pro, 2026b). Organic chemicals are more likely to partition into organisms when the log Pow is between 1.65-5 (Buell, 2025). This factor, along with many others (see Appendix I, Table B), are currently not included in the ProcellaCOR safety data sheet, despite their importance for understanding the true legacy of this herbicide in the environment.

Despite designations of overall safety found in the ProcellaCOR EC safety data sheet due to its small concentration of 2.7 % wet weight (w.w) (SePRO, 2017), FPB has GHS Hazard Statements warning of very toxic impacts on aquatic life with short and long-term effects (at 98.2%) (National Center for Biotechnology Information, 2026a). This may be due to its half-life measurements in water (see Appendix I, Table C), which states that in waters with a neutral to acidic pH, it may persist between 100 and 900 days. FPB also has an n-octanol/water coefficient between 3 and 5 (SePRO, 2017). FPB's n-octanol/water coefficient of 3-5 is conducive to lipophilic behaviour, meaning it is more likely to partition into organisms. Based on the safety data sheet produced by SePRO, FPB's potential for bioaccumulation is "moderate" (2017).

2.1.5 ProcellaCOR FX: Other Ingredients

Some other components in ProcellaCOR FX include Ethylhexanol (2.1% w.w) and Methanol (0.9% w.w), with some auxiliary ingredients (94.3% w.w) (SePRO, 2017). Both Ethylhexanol and methanol passed the OECD biodegradability tests, where 68% degraded over 10 days and 99% degraded over 28 days, respectively (SePRO, 2017). Ethylhexanol has a moderate bioaccumulation rating (log pow between 3-5), while methanol is low (log Pow < 3) (SePRO, 2017). These compounds thus do not pose as much of a risk to the surrounding environment as FPB itself.

2.2 Reward®

2.2.1 Regulatory History

Reward® is a contact herbicide federally registered in Canada (PCP #26271) under the Pest Control Products Act by Health Canada's PMRA (Health Canada, 2024). Although this specific herbicide is banned in many countries due to toxic effects to human health (Selypes et al., 1980), it was the only aquatic herbicide allowed in Canada for many decades (Breckels & Kilgour, 2018). The European Commission banned the usage of Diquat herbicides in 2018 (which came into effect in 2019) when it was deemed potentially harmful to wildlife, specifically birds, and having potentially long-term effects on groundwater, terrestrial and aquatic organisms by exceeding the Acceptable Operator Exposure Level (AOEL). In contrast, in 2018, greater than 500 000 kg of Reward®'s active ingredient was purchased and used in Canada (Health Canada, 2022). This may be due to its proposed inactivation when in contact with soils (De Souza & Machado, 2018) There was a proposal for the re-evaluation of the herbicide in 2008 due to the findings by the USEPA which suggested adverse effects on the environment (USEPA, 1995), but ultimately, it was ruled that the Reward® was safe for use in Canada, so long as the directions for use were followed (Health Canada, 2008). Reward® is manufactured by Syngenta Crop Protection, LLC or Syngenta Canada Inc. (2026a). Although there are many trade names associated with Reward®'s active ingredient, including Syngenta's Reglone® Desiccant and Reglone® Ion (Government of Manitoba, 2024), but only Reward® is registered as an aquatic (and limited terrestrial) herbicide, while the rest are targeted towards agricultural use such as crop management of tubers, canola, etc (Syngenta Canada Inc, 2026b; Syngenta Canada Inc, 2026c).

2.2.2 Classification

As a Group 22 herbicide, or otherwise known as Photosystem I (PSI) electron diverters (Crop Protection Network, 2023), Reward® is both adsorbed and absorbed onto and into a plant's tissues (Davies & Seaman, 1968) where it will act as a desiccant and a defoliant (National Library of Medicine, 2026b). The specific mode of action is further explained later on in this report. Reward is classified as contact, non-selective herbicide, which will locally target a plant (Health Canada, 2008), killing it as a "burn-down" agent, meaning it will kill the target plant from green foliage to base (similar to mowing grass) (Lawn & Pest Control Supply, 2026). It will not kill the roots of the plant (Glomski & Netherland, 2007). Reward® mainly targets free-floating and submersed macrophytes, as indicated by Syngenta including **EWM, coontail (*Ceratophyllum demersum*), duckweed (*Lemna*), canada water weed (*Elodea canadensis*), water soldier (*Stratiotes aloides*), among many others**. It is not meant as a control for species of macroalgae such as stoneworts and/or muskgrass (Syngenta Canada Inc, 2025). This herbicide is marketed for weed-management in lentic bodies of water with minimal to no continuous outflow, such as ponds, ditches, lakes (Health Canada, 2008), streams, and canals (Syngenta Canada Inc, 2025).

2.2.3 Active Ingredient: Diquat dibromide

The active ingredient in Reward® is a chemical named Diquat dibromide (DDB) (Figure 2), and this is the ingredient that causes the most damage to the targeted plant. This particular chemical was first synthesized in 1955 by Imperial Chemical Industries in the UK (Lawrence et al., 1962).

Chemical Profile

DDB was registered in 1964 as a chemical herbicide, modelled as a descendant of a previous chemical structure, Paraquat dichloride (Lawrence et al., 1962), one of the top-used herbicides in the United States (USEPA, 2025). Much like ProcellaCOR FX, the benzene ring structure makes this chemical compound very durable, and therefore persistent in the environment (Figure 2). Because there are two free radicals (i.e. the two unattached Bromine ions), it means that these ions are very unstable and are continuously undergoing an autooxidation process. It is for this reason that DDB is able to kill parts of photosynthesizing plants, such as EWM, so quickly (Dan Hess, 2000)

Mode of Action

As a Group 22 herbicide, the mode of action occurs through the inhibition of NADP+, an integral component for all cellular life during the second stage of photosynthesis, Photosynthesis I, where electrons are carried to designated spots to trigger all of the functional needs for growth (release of energy or oxygen, water dispersal, etc) (Cooper, 2000). As mentioned above, the autooxidation process of the two free radicals (negatively charged ions mistaken by NADP+ as important ions to carry throughout the plant) paired with the rapid electron transfers occurring during Photosynthesis I, allows the toxic effects of DDB to be so acute (Dan Hess, 2000).

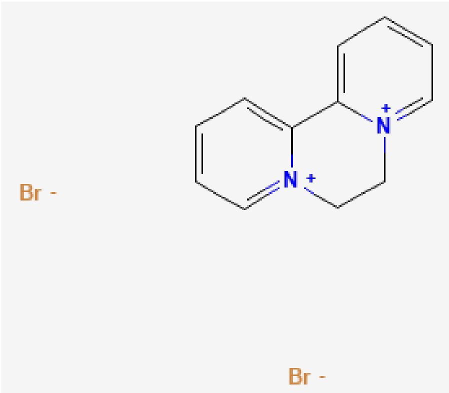

Figure 2. Chemical structure of Reward®'s active ingredient Diquat dibromide (molecular formula: $C_{12}H_{12}Br_2N_2$). (National Center for Biotechnology Information, 2026b)

2.2.4 Environmental Hazards Based on the SDS

Much like ProcellaCOR FX, environmental hazards include the depletion of a water body's oxygen budget from decomposing plant matter of the killed target macrophytes (Syngenta Canada Inc, 2025). Within their safety data sheet, Syngenta released different toxicity tests, such as LC50s, EC50s and NOECs (see section 2.1.4 for definition of these tests), for fish, aquatic macroinvertebrates, algae and aquatic macrophytes (2023). Fathead minnows experienced a 50% mortality rate in the sample population after exposure to 65.43 mg/L (LC50, 96 h). Half of the Waterflea (a macroinvertebrate) sample population were negatively impacted after exposure of 0.59 mg/L (EC50, 48 h). And the maximum amount of DDB green water algae could withstand before researchers seeing adverse effects in the population is 0.025 mg/L (NOEC, 72 h) (Syngenta Canada Inc, 2023). For context, it is recommended that invasive macrophytes, such as EWM, are to be treated with 18.3 L/ha of Reward® (if growing in 1.5 m of water or less) or 25-29.2 L/ha (if growing in waters deeper than 1.5 m). Young populations of EWM are to be treated with 9.2 L/ha (Syngenta Canada Inc, 2025). At an application rate of 25 L/ha of Reward®, across 1 hectare of water at a depth of 1 m, ~ 0.000925 mg/L of the active ingredient (DDB) will enter the system. Both the Fathead minnow and the Waterflea, would not be at risk if exposed to this amount of DDB after one treatment.

DDB's persistence in soil extended beyond 30 days, with a dissipation time in soils between 11-41 years, and it has also been marked as "persistent in water" (Syngenta Canada Inc, 2023). There are many relevant chemical properties that are not provided in the safety data sheet (for full list of chemical and physical properties of Reward®, see Appendix I, Table E), which would make it difficult for one to decide whether or not Reward® is a safe option for chemical removal if they were to just consult the SDS. However, some of the values have been uncovered by other sources, which provide much needed context surrounding DDB's fate in the environment.

As Canada's most widely used aquatic herbicide, Reward® is commonly directly released into an environment, which may be harmful for non-target organisms and people. According to the National Center for Biotechnology Information, there are two GHS Hazard Statements warning of very toxic effects on aquatic life, both long and short term (2026b). The acute toxic effects of Reward® explains the short-term impacts of aquatic organisms. The long-term impacts may be due to its n-octanol/water coefficient of 4.6 at 20 C˚ (Health Canada, 2008), which would theoretically allow for bioconcentration of the chemical in fatty tissues. However in studies done on fish bioaccumulation, no residues in the fatty tissues were recorded (National Center for Biotechnology Information, 2026b).

Once a waterbody is treated, DDB, depending on the conditions of environment, should absorb to suspended soils and/or sediments due to the divalent cation structures which more readily bind to organic carbon and clay than molecules with no charge (National Center for Biotechnology Information, 2026b). However, if DDB does not come in contact with fine suspended sediments and/or organic sediments, there is potential for it to migrate to the water's surface (Health Canada, 2022), which could be problematic to non-target organisms.

3.0 Application Process & Perspectives from Cottagers

3.1 ProcellaCOR FX

3.1.1 Procedure For Extermination Application: Interview with the MECP

During the research period for this project, the Pesticide Specialist from the Ministry of the Environment, Conservation and Parks (MECP), Tim Hannah, agreed to meet with me to discuss the application process for ProcellaCOR FX. The following information is what was garnered from our interview as personal correspondence (2026).

When it comes to the chemical removal of EWM, ProcellaCOar FX is often first prescribed by the MECP. Prior to chemical treatment, a request must be sent to a lake's regionally specific MECP representative with the required information. This includes, but is not limited to, the information of the person with the aquatic vegetation exterminator licence (typically the person sending in the application), the total area that requires treatment, estimated date of removal, and proof that the Milfoil population is indeed the non-native EWM and not the native northern watermilfoil. Depending on the request and waterbody's location on either Federal or Provincial land, this information is then passed along for secondary approval from the Department of Fisheries (DFO), under Section 19 of the Aquatic Species

Regulation Fisheries Act, and/or the Ministry of Natural Resources. Once the regulatory bodies have approved the lake association or homeowners request, the exterminator must have attended a course held by SePRO to ensure complete competency of the applicator and to become “PRO Certified”; SePRO will not sell ProcellaCOR FX to an uncertified exterminator.

Applications will be denied if there is a large number of objectors, whether that is surrounding residents or the general public. If the homeowner or lake association is wanting to conduct a whole-lake treatment, rather than a localized-treatment, this is typically avoided in Canada, despite the history of whole-lake applications in the US. Possible infringements on local Treaty rights are also considered, as treatments may negatively impact culturally significant ecosystems, sources of food, etc. An example of this may be the occurrence of Mnoomin, or Anishinaabe rice, in or around the waterbody in question. Haliburton County does have waters with growing and cultivated Mnoomin patches.

All treatments must occur within a specific timeframe throughout the year, depending on the locations. Most treatments occur between mid July- late August, unless it is located within the St. Lawrence River or any area within Ontario’s Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat where there may be important fish spawning habitat (i.e. certain marinas) where treatments must be conducted earlier outside of spawning season (DFO, 2013).

3.1.2 Procedure For In-Water Application

Application of ProcellaCOR FX to an area requires in-water treatment near, or directly on, the target plant, which includes floating, emergent, and submergent aquatic plants (SePRO, 2025). Access to target plants requires a boat and application of the herbicide is often completed by hydraulic handgun (SePRO, 2025). Although there are no restrictions on recreational use or indigestion of treated water, treatments may not occur less than 14 days apart (SePRO, 2025). When it comes to the actual application of ProcellaCOR FX to a waterbody, the manufacturer of ProcellaCOR, SePRO, requires all registered exterminators to apply the herbicide according to the appropriate number of Prescription Dose Units™ (PDUs) needed at a site (SePRO, 2026). 1 PDU is equal to 3.2 fl.oz per acre-foot of water and/or foliage. According to SePRO, the maximum application rate of PDUs per acre-foot of water are 25 (applied 3x a year) and 10 (applied 10x a year) (SePRO, 2026).The calculation is as follows:

$$\text{fl.oz needed} = \text{number of acres} \times \text{average depth (ft)} \times \text{PDU} \times 3.2$$

Post-treatment, the targeted macrophytes, such as EWM, will slowly deteriorate over the following weeks and will completely die-off after 4-5 weeks (Farlain Lake Community Association, 2023). However, depending on the time of year, maturity of plants, and/or flow rate of the waterbody, the target plant may necessitate higher application rates. Group 4 herbicides, such as ProcellaCOR FX, may also not be used more than 2 years in a row because the targeted macrophyte may develop a resistance, rendering the chemical ineffective (SePRO, 2025). Proper PPE requires minimal skin showing (i.e. must wear long sleeves, pants, waterproof gloves, socks and close-toed shoes) along with protective eyewear (SePRO, 2025).

3.1.3 Interview with Farlain Lake

There are currently only a few applications that have been approved by the MECP for treatment of EWM using ProcellaCOR FX, including some lake associations, residential waterfronts, and marinas (T. Hannah, personal correspondence, February 25, 2026). Of these, members of the Farlain Lake Community Association agreed to speak with me on their experience with ProcellaCOR FX as a management tool for EWM. The following information is what was shared during the interview (B, Kelso., & S, Dales, personal correspondence, March 18, 2026).

Around 2012 to 2013, a member of the MNR noticed a population of EWM while conducting a biological assessment of Fairlane Lake, near Midland, Ontario. After several years of removal attempts of the EWM population (including burlap benthic matting, driver assisted harvesting programs, volunteer-led hand pulling, and chemical treatment with Reward®), dwindling funds, and 16 new locations spawning throughout the lake prompted members of Farlian Lake Community Association to try chemical removal with ProcellaCOR FX. Despite delays during the COVID pandemic, Farlian Lake's application, which included the location of Farlain Lake and their plan of eradication, was accepted in 2023-2024. Through the help of the Trillium grant supplied by the Government of Canada, the high costs of using ProcellaCOR (~$20,000) were covered, making Farlain Lake the first lake to be treated with ProcellaCOR FX in Ontario in the late summer of 2024. Costs will vary based on size and severity of EWM patches.

SePRO hired a US-based extermination company, Solitude Lake Management, for the spot-treatment of 17 different locations throughout Fairlane Lake. Solitude Lake Management used an air boat, pump, and reservoir to treat the 17 locations in ~ 1½ -2 hours (Figure 3). Members of Farlian Lake noticed signs of stress in the EWM populations after 2-3 weeks and then complete die-off after a month until the EWM was no longer visible because it fell to the bottom of the lake. Each year, representatives from Solitude Lake Management and SePRO visit Farlain Lake to monitor its progress.

Figure 3. Treatment of Farlain Lake by Solitude Lake Management using ProcellaCOR FX.

No negative consequences have been recorded yet by Farlain Lake and they are proud of their healthy Walleye and native macrophyte populations, despite the reappearance of the original EWM population in the summer of 2025, which must be spot-treated with ProcellaCOR FX for a second time. There were ~ 12-13 properties of the over 300 properties surrounding Farlain Lake who objected to the decision to use ProcellaCOR FX. However, if a property does not lie within 100 ft of a treated area (not the lake itself, only the EWM patch), then the applicants are not required to inform the resident.

3.2 Reward®

3.2.1 Procedure for Extermination Application

All handlers of the Reward® aquatic herbicide are required approval from MECP and a permit, as per Section 7(2) of the Pesticides Act (1990), along with the proper water exterminator license, as per O. Reg. 63/09: GENERAL under the Pesticides Act (Government of Ontario, 2024). Unlike SePRO, the manufacturer of Reward®, Syngenta, does not require exterminators to acquire a secondary special certificate for approval of use.

3.2.2 Procedure For Foliar Application

According to the approved pamphlet for Reward® by Syngenta Canada Inc, the recommended application rate to EWM is 9.2 L/ha, specifically in young stands. In waters deeper than 1.5 m, the recommended application rate is 25-29.2 L/ha and in waters shallower than 1.5 m, 18.3 L/ha is recommended (Syngenta Canada Inc, 2025). However, within the PMRA's re-evaluation in 2008, they called for a reduced application rate of 2.3 to 4.5 L in a minimum of 225 litres of water per hectare (Health Canada, 2008). Applications must occur 2-weeks apart to prevent adverse effects on non-target organisms (Health Canada, 2008) and should not occur when winds are > 1 km/ hr (Syngenta Canada Inc, 2025).

Some restrictions apply when using this herbicide and includes no recreational use or animal consumption of treated water under 24 hours after application. Human consumption and irrigation restrictions extend for a minimum or five days post-treatment (Syngenta Canada Inc, 2025). Currently, the maximum acceptable concentration of DDB in drinking water is 0.07 mg/L (Health Canada, 2022). It is also not recommended that areas of dense growth be treated more than ~25% at a time, so as to prevent excessive plant die-off, decomposition, and fish suffocation (Syngenta Canada Inc, 2025).

As an environmental precaution, Syngenta requires exterminators to abide by the recommended buffer zones. Within Syngenta's pamphlet, these buffer zones only apply to terrestrial usage (see Appendix I, Table F) (Syngenta Canada Inc, 2025).

4.0 Literature Findings

4.1 ProcellaCOR FX

4.1.1 Native and Non-Native Species Responses

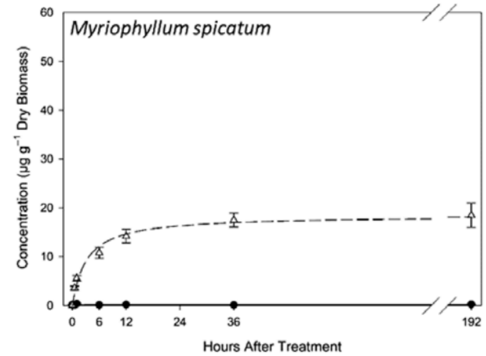

Figure 4. Hyperbolic regression model of the uptake of ProcellaCOR FX active ingredient by EWM shoot tissues, taken from a 2021 study (Haug et al).

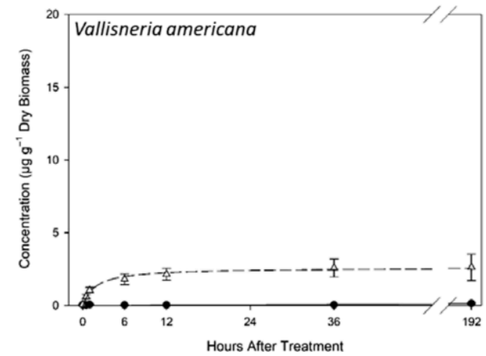

Figure 5. Hyperbolic regression model of the uptake of ProcellaCOR FX active ingredient by *V. americana* shoot tissues taken from a 2021 study (Haug et al).

In a study conducted by Haug et al, ten varying aquatic macrophytes, mainly non-native and one native (American eelgrass (*Vallisneria americana Michx.*)), were exposed to the synthetic auxin, FPB, in an attempt to measure the rapidity of uptake, translocation and any variations that may occur throughout species' and environments (2021). Treatments were administered to shoots at a rate of 10 µg/L FPB in 6 separate mesocosms. It was found that non-native and invasive species were more likely to uptake FPB at a faster rate in comparison to the native *V. americana* (Haug et al., 2021). For example, EWM and *V. americana* exhibited a fairly significant difference in their reaction to FPB, which indicated *V. americana's* greater resistance to the synthetic auxin in comparison to EWM in laboratory settings (Figures 4-5). After 6-192 hrs, while the EWM absorbed > 20 µg/g *V. americana* absorbed > 5 µg/g of the active ingredients (Haug et al., 2021). EWMs inability to repel FPB may explain why it responds so significantly to treatments, while native macrophytes are often visibly less affected.

Next, in 2023 the dynamics between EWM, hybridized EWM, and ProcellaCOR FX application to quadrants inside an inland lake in the Laurentian Great Lakes region was studied (Davidson). Two main areas were treated at an application rate of 12.68 oz/ac ft at a depth of 1m. The most interesting, and relevant, finding of this study for Drag and Spruce Lake are the responses of the native aquatic macrophytes in the treated inland lake. Nine native species were measured for frequency of occurrence (FOO) pre- and post-treatment and it was found that once the hybrid EWM had died-off, the native species either increased or maintained their previous numbers (Figure 6).

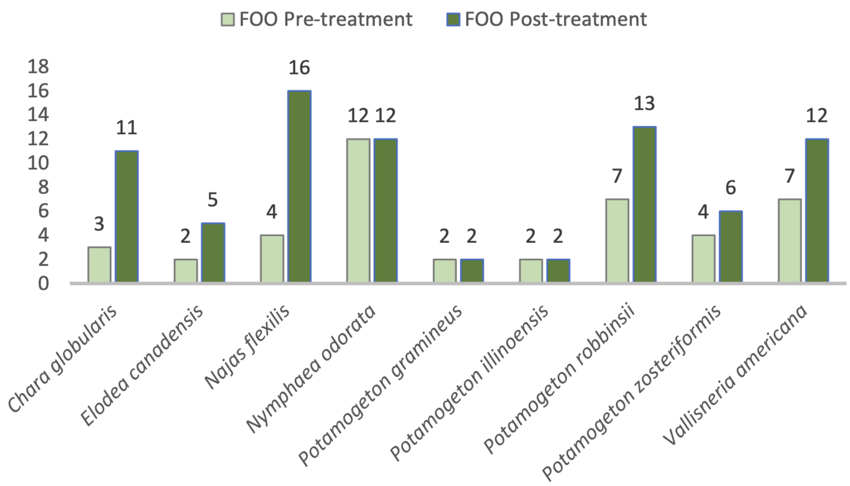

Figure 6. The responses of aquatic macrophytes to ProcellaCOR before and after treatment after monitoring for > 4 weeks. Figure taken from the study by Davidson (2023).

4.1.2. Legacy and Non-Target Impacts

On the ProcellaCOR EC label, there are warnings of oxygen depletion causing fish suffocation (2025). A study done in 2021 measured the effects of 55-acre (Figure 7) ProcellaCOR FX application on the oxygen demand in a cove waterbody during the summer (Lamb et al). The herbicide was applied at a rate of 3 PDUs/ ac-ft. Here it was found that immediately after treatment (between 3-10 days) there was a decrease in dissolved oxygen, and thus an increase in the biological oxygen demand. Oxygen levels did not stabilize until 42 days later, where it was determined more available dissolved oxygen was present *post*-herbicidal treatment than *pre*-herbicidal treatment (Lamb et al., 2021).

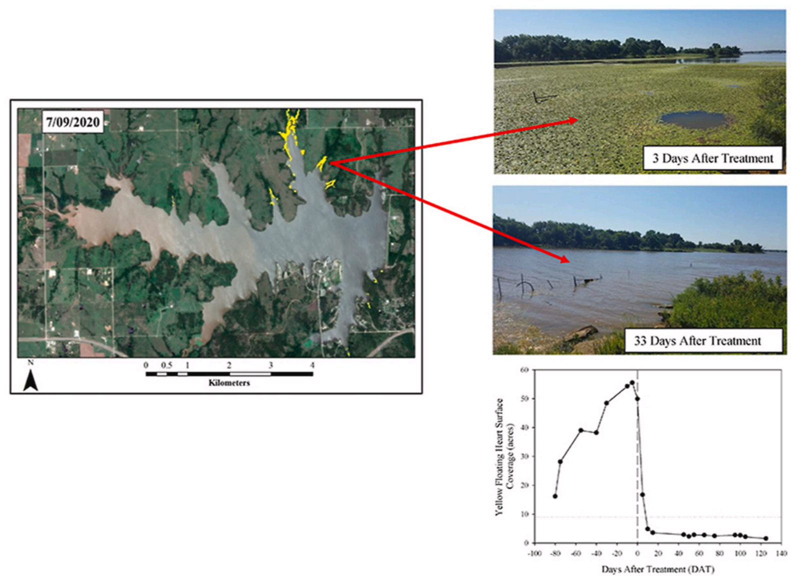

Figure 7. Image taken from Lamb et al., 2021 to illustrate total area treated (55 acres, highlighted yellow).

ProcellaCOR FX and its active ingredient FPB are said to undergo photolysis, which is a compound's degradation due to exposure to the sun, and hydrolysis which is a compound's degradation from exposure to water, both of which are said to decrease ProcellaCOR FX's half-life significantly (Farlain Lake Community Association, 2023). However, as seen in the ProcellaCOR EC safety data sheet, the half-life of ProcellaCOR FX due to hydrolysis is a long process that can be affected by pH (see Appendix I, Table C). This may be due to SePRO researchers testing hydrolysis rates in filtered water, rather than in-situ lake water. In 2023, a study was completed on hydrolysis rate/half-life of ProcellaCOR FX (see Appendix I, Table G), where it can be seen that greater half-lives occurred mainly in ultrapure or filtered water samples as the samples became more acidic (Zhou et al). However, when using lake water (pH = 6.54, which is slightly more acidic than in Drag and Spruce Lakes), the half-life decreased to 24.13 d (Zhou et al., 2023).

It was found in a 2023 lake study that through hydrolysis, FPB is degraded into florpyrauxifen, which is less likely to undergo further hydrolysis or photolysis (White et al). The estimated half-life for FPB (in real-world scenarios) are approximately < 1-3 days. This was investigated further through photochemical modelling which estimates that florpyrauxifen located on the water's surface (top 1 cm), with an average exposure to sun, will remain there for 68 days (White et al., 2023). During their in-lake study, treatments were applied and florpyrauxifen was recorded for ~30 days afterwards. Therefore, it is assumed that the pathways responsible for FPB degradation follows this material balance: hydrolysis (~47% of loss), biodegradation (~20%), sorption (~13%), and photodegradation (~4%) (White et al., 2023). However, FPBs that do not undergo hydrolysis into florpyrauxifen often degrade into four other byproducts, which may remain in the water column and sediments longer than the parent chemical (White et al., 2023). There was also accumulation of FPB and florpyrauxifen recorded in the sediments of the lakes that had been treated up to 50 days post-treatment (White et al., 2023). However, in another study, FPB and its constituents were found in Blairs Bay and Sheep Meadow Bay sediments a year after treatments, which may deem harmful for benthic macroinvertebrates in the future (Wiltse et al., 2025).

4.2 Reward®

4.2.1 Native and Non-Native Species Responses

A study completed in 2018 on the effects of varying treatments concentrations of DDB on native and non-native aquatic macrophytes, including Canada waterweed (*E. canadensis*), EWM (*M. spicatum*), and Coontail (*C. demersum*), found severe adverse effects to each plant after DDB exposure (Sesin et al). More interestingly, however, these severe adverse effects (whether it was the beginnings of die-off or complete eradication in some of the more sensitive species) were recorded at 4.7 - 1,153 µg/L applications. Complete die-off occurred at 74 µg/L (Sesin et al., 2018) (Figure 8). This is a *much* lower concentration than Syngenta's recommended rate of application (ranging from 9.2 L/ha - 29.2 L/ha, depending on conditions) (2025). Something to consider is the total volume of water per sample in comparison to treatments occurring in a lake-wide system, but this may indicate the need for a better understanding of Reward®'s potency in the environment. These findings are corroborated by another study published in 2025, which recorded macrophyte die-off at all experimental concentrations ((18.3 L/ ha; 1153 µg/L) to 6.4% (1.2 L/ha; 74 µg/L)) (Dalton et al). This would also explain the PMRA's request to reduce the application rate (Health Canada, 2008).

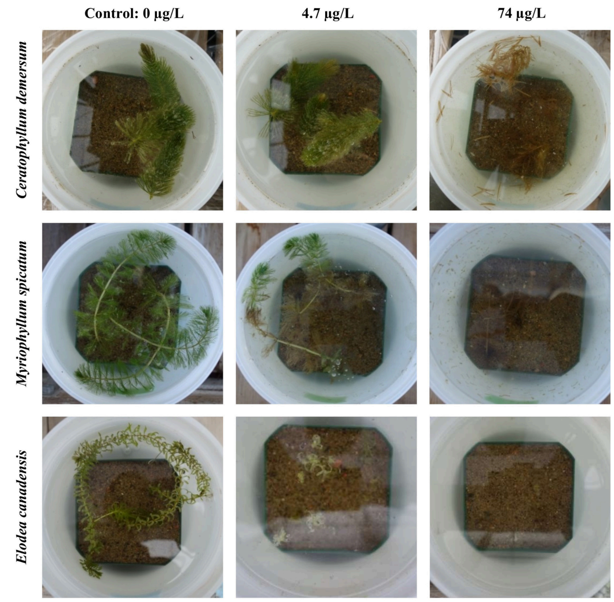

Figure 8. Treatments consisting of a control, lowest, and highest concentrations of Reward® on *C. demersum*, *M. spicatum* and *E. canadensis*. Image taken from Sesin et al., 2018.

Legacy and Non-Target Impacts

Sesin et al argue that the absorption of DDB into a macrophyte's tissues encourages accumulation and therefore the potential for delayed contamination once the plant begins to decompose (2018), especially if applicators are consistently treating areas with excessive amounts of the herbicide, allowing for more of the xenobiotic to enter the plant's system (target or non-target). This along with DDB's acute effects (Dan Hess, 2000), it must be assumed that native/ non-target populations will be unintentionally negatively affected. If gouges are made in the native populations within any waterbody, there is risk of disrupting the ecosystem's trophic scale, or food chain, of not only aquatic macrophytes, but aquatic macroinvertebrates and others living in the waterbody (Sesin et al., 2018).

In 2020, a study was released on the impacts DDB may have on the different stages of Rainbow trout development and procreation (McCuaig et al). To do so, the researchers mimicked the guidelines set by Syngenta for exterminators (2025) in mesocosms where Rainbow trout were present. Some of the juvenile feeding fry and eyed embryos underwent two-24h pulse exposures of 9.8 mg/L, the recommended application rate, while others were exposed to different concentrations (0.12-10 mg/L) (McCuaig et al., 2020). After the 24 h, the fish were placed in freshwater for 14 d before the secondary treatment (as specified by Health Canada, which states treatments may not be within 2 weeks of one another) (2008). Toxic effects to the embryos were recorded at 9.3 mg/L (McCuaig et al., 2020), potentially causing harm to the reproductive cycle of trout in treated lakes and other aquatic systems. This is in contrast with Syngenta's studies which found LC50 results of 10.46 mg/L in rainbow trout population samples (2023).

5.0 Discussion: Considerations for Drag and Spruce Lake

5.1 The Boom-and-Bust Lifecycle of EWM

An important aspect to EWM management is understanding the lifecycle of this particular aquatic macrophyte and how that may affect its populations in lakes and other waterbodies. Since its introduction to North America in the Belch Spring Pond in Washington, D.C. in 1942 (Couch & Nelson, 1985), there have been many recordings of its "boom and bust" cycles, where the populations will flourish into dense monocultures and then almost immediate die-off, in a constant cycle spanning multiple years (Nichols, 1994). There are many proposed reasons behind this lifecycle pattern, including inconsistent nutrients, some sort of lethal pathogen (fungal, bacterial or viral), predation from an insect, such as the weevil, *Euhrychiopsis lecontei* (Roley & Newman, 2006), or competition from another species (Simberloff & Gibbons, 2004). It is entirely possible that the population of EWM in Drag and Spruce Lakes will also follow this boom and bust pattern lifecycle, if it isn't already, even without herbicidal intervention. It is also entirely possible that chemical treatments may prevent the natural boom and bust cycle of the EWM, allowing the EWM to constantly be in a state of a "boom" after an induced "bust" (Trebitz et al., 1993).

Another consideration is the importance of examining the success stories from other lake associations, residences, and waterfront associations. As told by the Farlian Lake representatives, complete eradication of EWM was not achieved (and most likely won't be), since the original population did come back after a few years post-treatment and the lake is constantly visited by outside cottagers and their boats. Therefore, the presence of EWM indicates potential for these boom and bust cycles, where, as long as there is a population it will find a way to reproduce and multiply until it eventually dies-off. Additionally, chemical treatments cannot be done multiple years in a row (of both ProcellaCOR FX and Reward®), due to the risk of the EWM population developing a resistance to a herbicide's active ingredient (SePRO, 2025; Syngenta Canada Inc, 2025).

5.2 Is ProcellaCOR FX a Forever Chemical (PFAS)?

There is currently a debate in many parts of the United States, and even amongst the European Commission (SCHEER, 2025), as to whether or not ProcellaCOR FX's active ingredient should be considered a Per- and polyfluoroalkyl substance (PFAS), specifically with the Minnesota Department of Agriculture which currency recognizes FPB as as PFA (Minnesota Department of Agriculture, 2026). PFAS are a group of synthetic chemicals that have been deemed "forever chemicals" due to their inability to break down in the natural environment. This persistence in the environment comes from their strong carbon-florine (C–F) chemical bond, which does not typically occur in the natural world (Sauer, 2025). Many negative health effects and diseases have been linked to PFAS, including cancers, reproductive disorders, endocrine disruption, liver and kidney diseases, and immunological diseases (Cirella et al., 2024). PFAS bioaccumulates both in the environment as well as in human tissue when consumed, and there has been an international push as of late to halt the production of PFAS due to their toxicity and persistence in the environment (Government of Canada, 2026).

As previously mentioned, ProcellaCOR FX is very persistent in the environment, which is showcased in its inability to degrade when introduced to a system, specifically sediment and soils (Wiltse et al., 2025). Although ProcellaCOR FX is not registered as a PFAS, it is eerily similar to one. PFAS, or polyfluorinated alkyl substances, are a highly variable and diverse group of chemicals that are known for their extreme persistence in the environment. The Organisation for Economic Co-operation and Development (OECD) defines PFAS as:

> ...fluorinated substances that contain at least one fully fluorinated methyl or methylene carbon atom (without any H/Cl/Br/I atom attached to it), i.e. with a few noted exceptions, any chemical with at least a perfluorinated methyl group ($–CF_3$) or a perfluorinated methylene group ($–CF_2–$) is a PFAS (OECD, 2021). (see Appendix II, Figure A for an illustration of what these bonds look like)

Therefore, in the case of ProcellaCOR FX and its active ingredient FPB, it does not meet the definition of a PFAS placed by the OECD. Although two fluorine atoms *are* present, the two of them are not attached to one carbon (i.e. a perfluorinated methylene group ($–CF_2–$)) , but rather two *separate* carbon bonds (Figure 9).

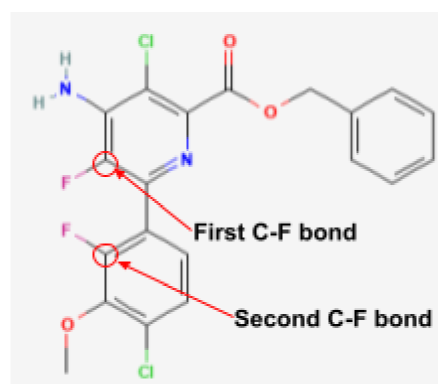

Figure 9. Same image as Figure 1, but with the individual carbon bonds highlighted to illustrate why FPB is ***not*** considered a PFAS

However, something must be said about FPB's longevity in the environment under specific conditions. Whether or not FPB can or should be considered a PFAS, it does not change the fact that both the C–F bonds present in the molecular structure, which is a synthetic bond made in a laboratory that does not occur in the natural environment (Sauer, 2025), and the benzene rings, are both extremely hard to break in the environment (Crimmin, 2021). Wiltse et al's study (2023) along with the EPA, found FPB to maintain in soils for 30-55 days post-treatment (Meléndez et al., 2017). However, these studies were done outside of the Canadian Shield in neutral- alkaline sediments (Wiltse et al., 2025). As we know, FPB's half-life may increase under acidic conditions (SePRO, 2017; Zhou et al., 2023), which may be perpetuated by ProcellaCOR FX itself once it is introduced to a system, as it is an acidic compound (pH = 4.24) (SePRO, 2017). Being located on the Shield, Drag and Spruce Lake may have more acidic soils and sediment than the aforementioned lakes, so the true legacy of ProcellaCOR usage may be highly variable and persistent.

according to the OECD. (National Center for Biotechnology Information, 2026a)

5.3 Is Reward® a Viable Option?: Possible EWM Resistance & Water Contamination

Of the two herbicides, Reward® is not recommended for EWM management in Drag and Spruce Lakes, simply due to its inability to kill the entire plant, as seen with Farlian Lake's accounts and in other studies (Glomski & Netherland, 2007). Because of this, multiple treatments would be necessary to somewhat manage the EWM populations at Drag and Spruce Lakes which may increase the exposure of harmful chemicals over a long period of time. If residents are using the water directly for home-use or drinking this may be harmful, especially since there is a delay in the use of the water post-treatment (Syngenta Canada Inc, 2025).

Furthermore, in the pamphlet for Reward®, there is an entire section dedicated to the prevention of macrophyte resistance to the Group 22 herbicide (Syngenta Canada Inc, 2025). In this section, it warns the user that repetitive use of Reward®, or any Group 22 herbicide (which attacks the Photosynthesis reactions in a plant) (Cooper, 2000), will force the treated populations to develop a resistance in the hopes of its own survival. They recommend using a mixture of different aquatic herbicides belonging to different herbicidal groups (Syngenta Canada Inc, 2025). This, however, is not a very accessible solution in Ontario since the only other permitted herbicide in Canada is ProcellaCOR FX, a much more potent herbicide which would completely negate the need for Reward® anyways.

Currently, there are not many scientific articles on EWM's development of resistance to ProcellaCORFX. However, it is not recommended for the use of ProcellaCOR FX for more than 2 years in a row due to the possibility of macrophyte resistance (SePRO, 2025).

5.4. Post-Treatment Outcomes: Secondary Invasion or Native Reintroduction?

Lastly, complete and permanent eradication of a species is highly unlikely and very difficult to achieve without proper precautionary measures, etc (Hussner et al., 2017; Pluess et al., 2012).

Experiences by Farlain Lake with the recurrence of EWM after spraying is not uncommon within invasive species management. However, large reductions in the population are still possible and as long as these gaps in the environment are filled with native species, then the treatment can be considered a success. If these gaps are not filled in by native species, however, either by the DSLPOA or through natural processes, further problems may arise due to the reinvasion of an invasive species.

Once an advantageous species such as EWM is removed from an area, there is always a risk that a new, equally as aggressive (if not more so), will colonize the area where EWM is no longer taking up space. This process is called "secondary invasion". An example of this was seen in the United States, where the removal/eradication of the invasive European Common Reed (*Phragmites Australis*) led to the recolonization of another invasive species, European Frogbit (*Hydrocharis morsus-ranae*) (Robichaud & Rooney, 2020). There is also a possibility of EWM recolonizing an area for a second time before native species are able to, as seen with Farlain Lake, although most of the population of EWM was removed and they plan on re-treating this year.

To prevent this from happening, it would be very beneficial for the DSLPOA to adopt functional eradication methods, as proposed by Green and Grosholz (2021), into their restorative plans pre-treatment, if chemical treatment is so decided by the DSLPOA and its residents. Although their particular study revolved around invasive shellfish management, the principles remain the same and may be beneficial for DSLPOA stewards. If complete eradication is not possible, how will DSLPOA ensure the health and resilience of Drag and Spruce Lake for generations to come? Guides on goals and considerations to be had during active and passive restoration projects, such as in Figure 10, can be used to help determine the type of restoration needed in Drag and Spruce Lakes (Holl & Aide, 2011). Aquatic ecosystems can take up to 10 years to stabilize after a disturbance, which is a temporal factor that should also be considered by the DSLPOA, when deciding if restoration is a goal for DSLPOA post-spray.

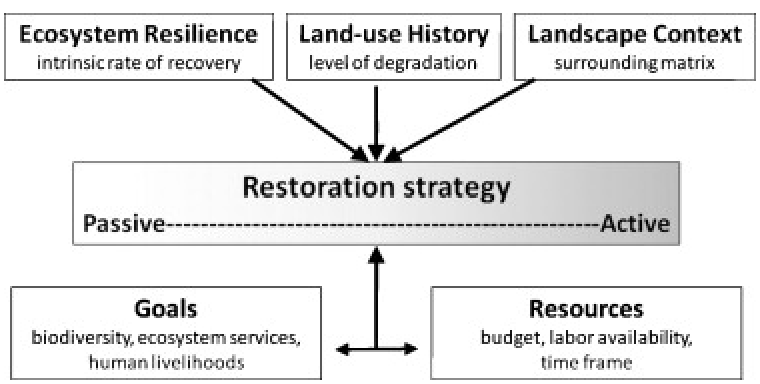

Figure 10. A chart on the type of restoration strategy is needed based on multiple factors. Image taken from Holl & Aide, 2011.

There is always a risk of a far more aggressive species, taking advantage of the now expansive bare areas where there was once EWM, or the EWM just coming back anyways, thus posing greater and possibly more complicated measures of management by the DSLPOA. In order to prevent this, it would be beneficial to at least have a restorative plan before spraying is to occur, if it is so decided by the DSLPOA and its residents, to plan for potential re-seeding of an area and other restorative projects to ensure the health and resilience of Drag and Spruce Lake for generations to come.

6.0 Conclusion & Recommendations

The Drag and Spruce Lakes system is currently experiencing an influx of EWM and the possibility of chemical management through aquatic herbicides is definitely an option for those who are concerned for the population dynamics of the lakes. However, there are many considerations to be had before such a decision is made.

As relayed by Farlain Lake (B, Kelso., & S, Dales, personal correspondence, March 18, 2026), any members or residents belonging to Drag and Spruce Lakes who are against spraying may not have any input in management strategies so long as the EWM treatment areas are not 100 ft from their property. Furthermore, if there are large amounts of those against chemical herbicide usage, this may impact the MECP's willingness to approve applications for treatment with ProcellaCOR FX (T, Hannah, personal correspondence, February 25, 2026).

Additionally, there are currently efforts in 2024 and 2025 by the Haliburton Forest & Wild Life Reserve, to reintroduce Mnoomin to the waterways of the Haliburton County area, and beyond (Smith, 2025). This is a traditional food source that would be utilized by surrounding Indigenous communities. Using ProcellaCOR FX on Drag and Spruce Lakes, which would be susceptible to Mnoomin seeds migrating and growing in these areas due to the interconnectedness of it to other waterbodies, may indirectly contaminate either the stalks, or the grain itself, posing a food security issue. Although there are currently no studies showing overt consequences towards native macrophyte populations after ProcellaCOR FX treatments (Davidson, 2023; Haug et al., 2021), its true legacy in the environment and the consequences of said legacy are still widely unknown (as discussed in section 5.2), especially in Mnoomin and other macrophytes used as food and medicine.

There are many risks associated with chemical herbicides, as discussed throughout this report, along with some successes. However, ultimately, chemical management should <u>not</u> be seen as a permanent solution to issues regarding invasive species. The EWM population at Drag and Spruce Lakes is mature enough that it would likely require more than a single treatment to reduce it. Chemical herbicides, such as ProcellaCOR FX and Reward® should be seen as a potential tool in the process of revitalizing an invaded aquatic ecosystem, so long as all consent to its usage. Chemical eradication is only helpful for the environment and long-lasting if there is a focus on ecosystem functionality and resilience.

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8.0 Appendix I

Table A. List of target plants by ProcellaCOR FX. (SePRO, 2025)

Vascular Aquatic Plants Controlled: In-Water Application	
Common name	**Scientific name**
Floating Plants	
Mosquito fern	*Azolla* spp.
Water hyacinth	*Eichhornia crassipes*
Emersed Plants	
Alligatorweed	*Alternanthera philoxeroides*
American lotus	*Nelumbo lutea*
Floating heart	*Nymphoides* spp.
Water pennywort	*Hydrocotyle umbellata*
Water primrose	*Ludwigia* spp.
Watershield	*Brasenia schreberi*
Submersed Plants	
Bacopa	*Bacopa* spp.
Coontail[1]	*Ceratophyllum demersum*
Hydrilla[1]	*Hydrilla verticillata*
Parrotfeather	*Myriophyllum aquaticum*
Water chestnut	*Trapa* spp.
Watermilfoil, Eurasian	*Myriophyllum spicatum*
Watermilfoil, Hybrid Eurasian	*Myriophyllum spicatum X M.* spp.
Watermilfoil, Variable	*Myriophyllum heterophyllum*

[1] Higher-rate applications within the specified range may be required to control less-sensitive weeds.

Table B. Condensed table from the ProcellaCOR EC Safety data sheet of the physical and chemical properties of ProcellaCOR (SePRO, 2017). All factors unknown due to lack of available data are highlighted in yellow.

Physical State	Liquid
Colour	Amber
Odour	Solvent
Odour Threshold	**No data available**
pH	4.24 (1% aqueous suspension)
Freezing Point	**No data available**
Boiling Point (760 mmHG)	**No data available**
Flash Point	> 100 °C (> 212 °F)
Evaporation Rate (Butyl Acetate = 1)	**No data available**
Vapour Pressure	0.0000002 mmHg at 20°C (68°F)
Relative Vapour Density (air = 1)	**No data available**
Relative Density (water = 1)	0.93
Water solubility	0.015 mg/l at 20°C (68°F)
Partition Coefficient (n-octanol/water)	**No data available**
Decomposition Temperature	**No data available**
Dynamic Viscosity	15.4 mPa.s at 20°C (68°F) 8.90 mPa.s at 40°C (104°F)
Kinematic Viscosity	14.2 mm2/s at 20°C (68°F) 7.91 mm2/s at 40°C (104°F)
Oxidizing Properties	Not oxidizing
Liquid Density	0.9257 g/cm3 at 20 °C (68 °F)
Molecular Weight	**No data available**

Table C. The corresponding half-life measurements for florpyrauxifen-benzyl in water with different levels of acidity. Information found in the safety data sheet for ProcellaCOR EC (SePRO, 2017).

	pH 4	pH 7	pH 9
Hydrolysis (DT50)	913 days	111 days	1.3 days

Table D. Prescription Dose Units (PDU) per acre-foot of water. Table taken from the SePRO ProcellaCOR EC label (2025)

Percent Area of Waterbody Treated	Target Species			
	Eurasian Watermilfoil	Hybrid Watermilfoil	Variable Leaf Watermilfoil	Other
≤ 2%	3 - 4	4 - 5	3 - 5	3 - 25
>2 - 10%	2 - 3	3 - 5	3 - 4	3 - 20
>10 - 20%	1 - 3	3 - 4	2 - 4	3 - 15
>20 - 30%	1 - 2	2 - 3	2 - 3	2 - 10
>30%	1 - 2	2 - 3	1 - 2	1 - 5

* In all cases, user may apply up to the maximum of 25 PDU per acre-foot. Consult your SePRO Aquatics Specialist for site-specific recommendations.
** 1 PDU contains 3.2 fl. oz. of product.

Table E. Condensed table from the Reward® Safety data sheet of the physical and chemical properties of Reward® (Syngenta Canada Inc, 2023). All factors unknown due to lack of available data are highlighted in yellow.

Physical State	Liquid
Colour	Dark brown
Odour	Odourless
Odour Threshold	**No data available**
pH	4-6
Freezing Point	**No data available**
Boiling Point	**No data available**
Flash Point	Method: Pensky-Martens closed cup does not flash
Evaporation Rate	**No data available**
Vapour Pressure	**No data available**
Relative Vapour Density	**No data available**
Relative Density (water = 1)	1.202 g/cm^3 (25 ˚C)
Water solubility	**No data available**
Partition Coefficient (n-octanol/water)	**No data available**
Decomposition Temperature	**No data available**
Dynamic Viscosity	**No data available**
Kinematic Viscosity	**No data available**
Oxidizing Properties	Not oxidising
Liquid Density	**No data available**
Molecular Weight	**No data available**

Table F. Table taken from the approved pamphlet for Reward® of the recommended buffer zones (Syngenta Canada Inc, 2025)

Method of Application	**Use Site**	**Buffer Zones (metres) Required for the Protection of:**		
		Aquatic Habitat of Depths:		**Terrestrial Habitat**
		Less than 1 m	**Greater than 1 m**	
Field sprayer[1]	Non-cropland (including rights-of-way[2])	10	5	5

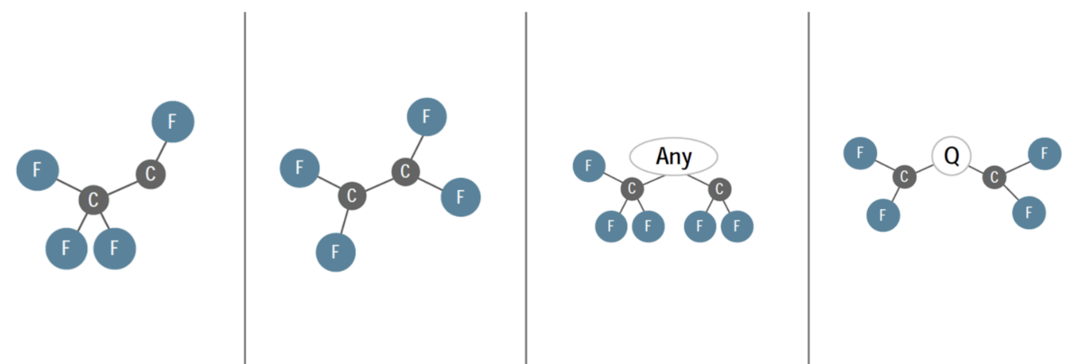
[1]For field sprayer application, buffer zones can be reduced with the use of drift-reducing spray shields. When using a spray boom fitted with a full shield (shroud, curtain) that extends to the crop canopy, the labelled buffer zone can be reduced by 70%. When using a spray boom where individual nozzles are fitted with cone-shaped shields that are no more than 30 cm above the crop canopy, the labelled buffer zone can be reduced by 30%.
[2]For application to rights-of-way, buffer zones for protection of sensitive terrestrial habitats are not required.

Table G. The half-life and hydrolysis rate of florpyrauxifen-benzyl in different water sources, pH, temperature (˚C), etc (n = 3)**.** (Zhou et al., 2023)

Water	Mass Concentration/mg L^{-1}	pH	Temperature/°C	Kinetic Equation	*R2*	Rate Constant (*k*)/d^{-1}	Half-Life (*T*0.5)/d
Ultrapure water	1	4	15	$C_t = 1021.11e^{-0.0042t}$	0.9772	0.0042	163.48
			25	$C_t = 960.23e^{-0.0031t}$	0.9537	0.0031	220.75
			35	$C_t = 972.30e^{-0.0034t}$	0.9630	0.0034	202.67
			50	$C_t = 994.75e^{-0.0034t}$	0.8538	0.0034	205.68
		7	15	$C_t = 1011.04e^{-0.0052t}$	0.9429	0.0052	134.59
			25	$C_t = 1154.46e^{-0.0409t}$	0.9708	0.0409	16.96
			35	$C_t = 1194.53e^{-0.0506t}$	0.9250	0.0506	13.70
			50	$C_t = 1199.24e^{-0.0702t}$	0.9154	0.0702	9.87
		9	15	$C_t = 970.39e^{-0.0086t}$	0.9403	0.0086	80.88
			25	$C_t = 1128.19e^{-0.0529t}$	0.9706	0.0529	13.10
			35	$C_t = 1111.91e^{-0.3573t}$	0.9875	0.3573	1.94
			50	$C_t = 989.59e^{-4.6981t}$	0.9850	4.6981	0.15
Ultrapure water	1	7	25	$C_t = 1154.46e^{-0.0409t}$	0.9708	0.0409	16.96
	2			$C_t = 2286.14e^{-0.0238t}$	0.9507	0.0238	29.10
	5			$C_t = 5016.71e^{-0.0039t}$	0.9717	0.0039	176.82
Ultrapure water	1	7.12	25	$C_t = 1154.46e^{-0.0409t}$	0.9708	0.0409	16.96
Tap water		7.34		$C_t = 1056.08e^{-0.0144t}$	0.9278	0.0144	48.04
Lake water		6.54		$C_t = 1150.18e^{-0.0287t}$	0.9541	0.0287	24.13
Paddy water		7.41		$C_t = 1159.70e^{-0.0238t}$	0.9551	0.0238	29.11
Seawater		8.18		$C_t = 969.31e^{-0.0270t}$	0.8850	0.0270	25.66

9.0 Appendix II

Figure A. Four Substructural Filters of PFAS Used in Development of USEPA's CompTox Dashboard for PFAS. Image and caption taken from Interstate Technology & Regulatory Council, 2026.
**Note: Q can be any of the following atoms: B, O, N, P, S or Si.*



1 2 3 4