

M E M O R A N D U M

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SUBJECT: FIPRONIL MITIGATION OPTIONS

Summary

Fipronil is a phenylpyrazole insecticide that is registered for use in pet flea and tick products and structural pest control products. Fipronil is not registered for agricultural use in California and does not have any non-pesticidal uses. The California Department of Pesticide Regulation (DPR) has determined that pet products containing the active ingredient (AI) fipronil pose risk to aquatic life and human health. This document summarizes these risks and the preliminary mitigation options DPR has evaluated to address the risks, and invites stakeholders to submit feedback and information regarding these mitigation options and any other potential mitigation option.

DPR has evaluated the potential acute and chronic risk to non-target aquatic organisms and determined that spot-on products for large and extra-large dogs pose acute risks and spot-on products for all dogs pose chronic risks.

DPR's assessment of human health risk, published in its 2023 Fipronil Risk Characterization Document, found that fipronil spray and spot-on products pose acute and chronic human health risks, particularly for groomers, home applicators, and children exposed through skin contact or incidental ingestion.

DPR has preliminarily evaluated stewardship and consumer education, use restrictions, and designating fipronil as a restricted material as possible options for mitigating its aquatic and human health risks. A stewardship and consumer education campaign is critical to addressing the identified aquatic and human health risks but is not likely to be sufficient as a standalone mitigation option. Use restrictions and restricted material designation can achieve meaningful reductions in risk, but pose challenges as well.

DPR is seeking public feedback on the mitigation options evaluated, as well as other possible mitigation options that DPR should take into consideration. DPR is also seeking additional information or data relevant to these and other potential mitigation options. If no mitigation strategy is identified that properly addresses identified risks, DPR may consider the cancellation of certain fipronil pet products to protect people and the environment.

Discussion of Aquatic and Human Health Risks

Aquatic Risk

DPR has evaluated the acute and chronic risks of fipronil spot-on products to non-target aquatic organisms using the Pesticide Registration Evaluation Model (PREM) version 6.0 (Luo et al., 2024). In July 2026,¹ DPR published a final memorandum explaining its acute

¹ The final memorandum and DPR's response to public comments submitted in connection with the prior draft memorandum are available at: <https://www.cdpr.ca.gov/report/fipronil-pet-products-potential-risks-to-aquatic-life/>

risk modeling approach and the resulting findings, titled “Fipronil Pet Products: Potential Risks to Aquatic Life”. Results of the modeling indicate that fipronil dog spot-on products labeled for use on large and extra-large dogs pose potential unmitigated acute risks to non-target aquatic organisms.

Separately, DPR has evaluated chronic risk to aquatic organisms using PREM and found potential chronic risks across all products intended for use on dogs at levels that exceed DPR-approved ecotoxicity values for registration (Appendix A). DPR is incorporating chronic risk into its consideration of fipronil’s risk assessment and mitigation because (a) wastewater is a pathway by which pesticides, many of which are not removed during treatment (including fipronil), continuously enter receiving streams, leading to persistent, chronic exposure for aquatic organisms, and (b) DPR monitoring data show a high rate of exceedance (81.3%) of the minimum United States Environmental Protection Agency (U.S. EPA) chronic aquatic life benchmark for fipronil in effluent samples (DPR, 2025a). Fifteen California waterbody segments are listed as impaired under Clean Water Act section 303(d) due to concentrations of fipronil and/or fipronil sulfone (a fipronil degradate).

As a screening-level tool, PREM is designed to capture “worst-case” exposures for registration review and has demonstrated reasonable agreement with effluent and surface water monitoring data, consistent with DPR’s performance expectations (Appendix B). PREM has also been used to evaluate other pet and down-the-drain products submitted for registration with DPR.

Human Health Risk

DPR’s 2023 Fipronil Risk Characterization Document (RCD) found that pet spray and spot-on products containing fipronil can expose groomers, pet owners, and children to levels that pose health concerns. The RCD identified risks for occupational and non-occupational handlers who apply these products, as well as for adults and children who come into contact with treated pets after application. U.S. EPA received data in 2022 and issued a revised human health risk assessment on June 30, 2025. DPR reviewed the data

and U.S. EPA's updated assessment and determined that no updates were needed relative to its 2023 RCD.

To evaluate the identified risks, DPR used the margin of exposure (MOE), which compares the expected level of human exposure with the level at which health effects were observed in laboratory studies. An MOE of 100 or higher is considered protective, while values below 100 indicate potential health risk. For fipronil, MOEs were calculated across acute, subchronic, and chronic exposure durations based on estimated absorbed doses for different user groups.

Risks were evaluated for both single-route exposures (such as dermal or inhalation) and aggregate exposures that consider multiple routes together. Aggregate assessments provide a more health-protective estimate. For groomers, adult home users, and adult residents (in the house where application occurs), dermal exposure was the dominant contributor to total risk. For children who interact with treated pets, both dermal exposure (from petting) and incidental oral ingestion (from hand-to-mouth contact) contributed significantly to overall exposure. Groomers experience the greatest risk as they treat multiple animals per day; home users treat far fewer animals, which was reflected in DPR's exposure estimates. Across several exposure scenarios, MOEs fell below the protective threshold, indicating potential human health risks from typical use of fipronil spray and spot-on products.

Table 1. Summary of exposure scenarios with aggregate exposure levels that indicate human health risks (Scanlan, 2023).

Product Formulation	Fipronil Use Scenario	Duration of Exposure	Routes of Exposure	MOE*
Spray	Applicator, groomer	acute	dermal + inhalation	14
	Applicator, groomer	subchronic	dermal + inhalation	1
	Applicator, groomer	chronic	dermal + inhalation	1
	Applicator, home user	acute	dermal + inhalation	40
	Post-application, adult	subchronic	dermal + inhalation	39

Product Formulation	Fipronil Use Scenario	Duration of Exposure	Routes of Exposure	MOE*
	Post-application, child	subchronic	oral + dermal + inhalation	17
Spot-on	Applicator, groomer	subchronic	dermal + inhalation	28
	Applicator, groomer	chronic	dermal + inhalation	28
	Post-application, child	subchronic	oral + dermal + inhalation	95

*MOE < 100 represents an exposure level that is detrimental to occupational and public health and safety.

Fipronil Pet Product Discussion

As of April 29, 2026, 55 topical fipronil pet products are actively registered in California: 26 spot-on products for dogs, 27 spot-on products for cats, and two pet spray products (Table F-1). There are nine manufacturers and an additional 12 sub-registrants of spot-on and pet spray products containing fipronil. DPR compiled a detailed list of fipronil pet products broken down by formulation and by registrant (Table F-2).

The aquatic risks described above likely result from use of the 26 spot-on dog products and two pet spray products because these products wash off during pet bathing, resulting in down-the-drain transport and discharge into surface waters (Teerlink et al., 2017; Budd et al., 2023; Perkins et al., 2024). Furthermore, as stated by the State Water Resources Control Board in its March 16, 2026, letter to DPR, “[w]astewater treatment plants (WWTPs) are unable to effectively remove fipronil and its degradates, with removal rates averaging only 21%, even at facilities employing advanced treatment technologies”. Therefore, DPR believes that a significant reduction of aquatic risk can be most effectively accomplished by mitigating the fipronil loading into wastewater from these products. Cat products likely do not result in aquatic risk because most cat owners do not bathe their cats regularly.

Human health risks that fall below the protective threshold of an MOE of 100 result from the two registered spray products and all 53 spot-on products (dog and cat), as products for all dog sizes and for cats lead to similar exposure. Therefore, DPR believes that it is

necessary to mitigate exposures from all 55 pet treatment products to sufficiently reduce human health risk.

Risk Mitigation Options

DPR has begun evaluating approaches to mitigating aquatic and human health risks that result from fipronil pet products, including voluntary stewardship and consumer education, use restrictions (via voluntary label amendment or use regulation), and designating fipronil as a restricted material.

As discussed below, DPR found that voluntary stewardship and consumer education, while critical to addressing the identified aquatic and human health risks, is not likely to be sufficient as a standalone mitigation measure. Additionally, DPR found that use restrictions and restricted material designation could lead to meaningful reductions in risk, however implementation of these restrictions may prove challenging and DPR is still evaluating and assessing their overall viability.

DPR seeks public feedback on the feasibility or limitations of these mitigation options and any other potential mitigation options that may achieve the necessary reduction in aquatic and human health risks. Additionally, DPR is seeking information that could be relevant to its evaluation of these mitigation options, including, but not limited to, information about consumer use and pet care practices. If no feasible mitigation option identified can achieve the necessary reduction, DPR may consider product cancellation.

Stewardship and Consumer Education

DPR has received feedback from preliminary stakeholder engagement that a voluntary stewardship and consumer education effort is a critical component to addressing the identified aquatic and human health risks, either as a preventative measure or to complement mitigation actions. Examples provided include downloadable materials, FAQs, and a product selection tool, targeted social media campaigns, provision of educational materials to retailers and industry professionals, and distribution of educational materials to consumers at point-of-sale. DPR acknowledges that stewardship

and consumer education could encourage practices that mitigate risks to human health and the environment caused by fipronil and improve consumer awareness of these risks.

DPR supports registrants who would like to be proactive and implement voluntary stewardship programs to educate retailers, professionals and consumers of the potential risks associated with fipronil products and ways to prevent or minimize exposure to such risk. With respect to spot-on pet products in particular, DPR believes a standalone stewardship and consumer education campaign is not likely to be sufficient because of the size of the intended audience (all dog and cat owners) and its lack of familiarity with pesticide regulation, among other reasons.

DPR requests feedback on stewardship and consumer education efforts, including information that would help shape a stewardship and consumer education campaign, including potential implementation options and how a campaign could serve as a compliment to and support various mitigation options, as well as information regarding the effectiveness of stewardship campaigns targeting a wide consumer audience.

Use Restrictions

Below are possible use restrictions DPR explored to reduce aquatic and human health risks, as well as some of the challenges to these mitigation approaches overall.

Use Restrictions – Mitigating Aquatic Risk

DPR considered use restrictions as a method of reducing aquatic risk based on the mitigation goal of lowering fipronil concentrations coming from wastewater such that, after the treated wastewater mixes with the stream, the predicted fipronil concentrations are below the U.S. EPA's lowest aquatic life benchmark for protecting aquatic life in 90% of wastewater-receiving streams in California (assuming no fipronil in upstream flows). To meet this goal, fipronil concentrations in wastewater effluent need to be reduced by about 72% compared to current levels (Appendix D). This estimate is based on existing effluent monitoring data (DPR, 2025a) and stream dilution factors in waterways receiving effluent (DPR, 2023; Adjidjonu et al., under peer-review).

Using the PREM, DPR evaluated whether reducing the number of applications, lowering the application rates, and/or imposing a “no bathing” restriction could achieve the necessary reduction of fipronil entering wastewater.

Technical details are presented in Appendix D.²

Possible use restrictions based on the PREM analysis are outlined below. There may be other use restriction values and combinations beyond those outlined that achieve an equivalent reduction and DPR welcomes additional information on these from stakeholders:

Use Restriction #1. Annual Application Limits

Existing registered labels prescribe 12 monthly applications for year-round flea and tick control. Reducing the number of applications to three per year, or to four applications combined with a 7-day post-application bathing restriction, would achieve the target percent reduction needed to meet the 90% protection level if use is consistent with the registered label. Table D-1 summarizes mitigation options capable of achieving the target goal.

Use Restriction #2. Reduce Application Rates

Another option is to reduce application rates, either through reduced volume or percent AI, within the product itself. However, achieving a 90% protective level would require a 28% reduction in application rate even when combined with a restricted bathing period and a reduction to six applications per year. It is unknown whether product efficacy could be maintained at these lower application rates.

² As stated above in the products discussion, cat spot-on products and pet sprays were not evaluated because their contributions of fipronil to wastewater are expected to be much smaller than those from dog spot-on products based on pet-bathing frequencies.

Use Restriction #3. No-Bathing Periods

Implementing a restricted 7-day no-bathing period following each application is expected to reduce mean wash-off from 21% to 16%, thereby lowering fipronil loading to waste stream by approximately 24%. The estimated loading would decrease by approximately 81% if the restricted no-bathing period were extended to 28 days (Teerlink et al., 2017). However, a 28-day restriction may not be feasible for some dog owners. According to a survey of 603 dog owners in the United Kingdom, nearly 19% wash their dogs every 2 weeks or more (Perkins and Goulson, 2023).

It is worth noting that, while the modeling indicates these options could achieve the desired reduction in fipronil loading into wastewater, there is a statistically significant seasonal pattern of increased fipronil concentrations during the warmer months, when flea and tick pressure is greatest in most of California (Appendix E). As a result, limiting treatments solely to flea and tick season may not meaningfully decrease concentrations during these peak months.

Use Restrictions – Mitigating Human Health Risk

Use restrictions present different considerations with regard to human health risks than with aquatic risk. DPR evaluated the following possible use restrictions for spray³ and spot-on products to mitigate human health risks.

Use Restriction #1 – Occupational Use Restrictions

Groomers have the highest exposure of any user group due to the number of pets they handle each day. Groomer exposures could potentially be reduced by either prohibiting groomers from applying fipronil spot-on or spray products expressly, by limiting the number of applications any one person can make in a given period, or by requiring

³ Registrants could decide to voluntarily cancel spray products. While this could reduce overall fipronil availability, it is unlikely to sufficiently mitigate aquatic risk and it would be up to the registrants' discretion.

personal protective equipment (PPE), such as chemical-resistant gloves and eye protection. Such reductions would:

- Eliminate the highest and most frequent occupational exposures
- Reduce acute, subchronic, and chronic risk to professional users
- Address the repeated daily exposures resulting in the lowest MOEs in the RCD

Requiring groomers to wear PPE when applying sprays or spot-on products would not result in a large enough reduction to meaningfully reduce subchronic and chronic human health risks alone; therefore, other restrictions would need to be implemented to achieve the necessary exposure reduction.

Use Restriction #2 - Reduce Application Rates

Reducing the amount of fipronil applied per treatment could lower exposure for both occupational users and households. Such reductions could be designed to address:

- Dermal exposure for applicators
- Transferable residues on pets that adults and children contact
- Incidental oral exposure for children through hand-to-mouth behavior

Use Restrictions – Challenges

Although the use restrictions described above could achieve the necessary reductions in aquatic and human health risks posed by fipronil pet products, they come with challenges.

First, DPR believes that use restrictions may not be as effective as anticipated because of the potential for use inconsistent with the restrictions (label instruction or regulation).

Many fipronil products have been registered for decades and long-time users may continue using products as they have grown accustomed, out of compliance with new use regulations or label amendments. Residential users are more likely to be unaware of pesticide use regulations entirely, or in the case of a label amendment, may fail to notice a

difference in directions for use.⁴ As stated above, any use restrictions would need to be paired with a robust stewardship and consumer education campaign. These outreach efforts would cover any new use restrictions and raise awareness that use could pose aquatic or human health impacts—such as clarifying that, despite being waterproof, the active ingredient can wash off a pet after treatment—as well as best practices when applying and caring for pets.

Second, the outreach necessary to inform stakeholders about a new use restriction could prove challenging and cost prohibitive. Generally, DPR conducts targeted outreach to inform a limited set of stakeholders who apply pesticides professionally (i.e. growers and licensed applicators) of any change to allowable uses. The outreach necessary to educate the general public (i.e., all pet owners in California) about either a new use regulation or changes to a product label would need to be extensive with unknown success in changing behavior. The general public is a much larger stakeholder group and generally much less attuned to communications from DPR. This potential for use inconsistent with the restrictions (as a result of consumer behavior patterns and/or ineffective outreach) is concerning, as the resulting real-world reduction in fipronil loading would likely not reflect the reduction intended by the restrictions.

Third, a reduction in the products' fipronil concentration or treatment frequency could result in a decrease in product efficacy and/or an increase in target pest resistance. DPR has not analyzed whether product efficacy could be maintained at lower application rates and invites stakeholders to submit relevant efficacy or pest resistance information so that the Department can analyze the potential effects of use restrictions.

DPR requests feedback on these possible use restrictions and other possible use restrictions, data and information related to impact of restriction to product efficacy and

⁴ Additionally, DPR received a comment in response to the Draft Aquatic Risk Memo cautioning that a “partial” mitigation strategy, such as a use restriction applicable only to products intended for large dogs, encourages off-label use as consumers may apply multiple units of products intended for small dogs to compensate.

pest resistance, and practical implications and likelihood of success from proposed use restrictions.

Restricted Materials Designation

DPR has evaluated the potential aquatic and human health risk reductions of designating fipronil or certain uses or types of fipronil products as a restricted material via rulemaking.

Generally, restricted materials can only be sold by DPR-licensed pest control dealers after the purchaser obtains an applicator license from DPR and a restricted materials permit from the local County Agricultural Commissioner (CAC). The applicator must then submit a Notice of Intent (NOI) to the CAC before applying the product. Users of products containing a specific active ingredient may be exempted from restricted material permitting, NOI, and reporting requirements.

Designating fipronil as a restricted material would limit the overall accessibility of fipronil pet products as they would only be available at DPR-licensed pest control dealers. Moreover, DPR-licensed applicators are generally professional agricultural or structural pest control companies or individuals, not groomers and home users. Therefore, designating fipronil as a restricted material is likely to result in an overall reduction in use and in turn a decrease in fipronil loading into wastewater. However, the designation alone would not reduce exposure to groomers and home users (and residents and children in the same space) that are able to secure access to the products, and exposure to those users would continue to pose risk to human health without additional use restrictions.

Moreover, DPR acknowledges there are practical challenges of designating fipronil spot-on pet products as restricted use materials. Since these products are mostly used by professionals, such as veterinarians or groomers, and consumers, applying this designation may have practical implications for these users, including additional regulatory requirements for reporting and recordkeeping, in addition to those outlined above.

DPR is requesting feedback on the viability of designating fipronil pet products as a restricted material, as well as regulatory, practical and socioeconomic impacts of the designation and potential for illegal or misuse of products that do not meet restricted material requirements.

Fipronil Alternatives

DPR is actively evaluating alternatives to spot-on flea and tick pet products that contain fipronil. In the memo titled “Economic and Pest Management Evaluation of Fipronil Spot-On Pet Products in California”, DPR estimated the potential economic impact of consumers switching to alternative chemical spot-on flea and tick products. In addition to the alternative spot-on products, a wide range of non-fipronil products already exist, including medicated collars, sprays, shampoos, and oral medications (i.e., chewables).

In addition to chemical alternatives, DPR also reviews non-chemical integrated pest management (IPM) and sustainable pest management (SPM) approaches. These methods reduce pest pressure through non-chemical practices such as vacuuming, laundering pet bedding, regular flea combing, and maintaining clean indoor and outdoor environments. Between 2020 and 2024, the Bay Area Clean Water Agencies (BACWA) published materials identifying alternative non-chemical practices that could be used in place of fipronil and DPR’s IPM Branch concurred with these practices (DPR, 2025c).

These alternatives offer important advantages in addressing the risks identified in the fipronil assessment:

- Reducing aquatic risk: Unlike fipronil, many alternative active ingredients do not persist through wastewater treatment or do not pose the same level of toxicity to aquatic organisms. Non-chemical IPM tools also avoid chemical runoff entirely, reducing the amount of pesticide entering wastewater systems.
- Reducing human health risk: Non-fipronil products often result in lower dermal exposure for applicators and pet owners, and many oral medications eliminate

skin-to-skin transfer entirely. This helps reduce risks to groomers, home applicators, and children who frequently touch treated pets.

- Maintaining effective pest control: Pet owners still have access to a broad range of effective flea and tick management tools even if fipronil use is reduced or eliminated.

Although some non-chemical approaches cannot be easily quantified in economic or environmental models, they provide practical, low-risk, and widely accessible strategies that can significantly reduce dependence on fipronil products.

Conclusion / Request for Feedback

DPR's evaluations show that fipronil pet products pose risks to both aquatic life and human health when used according to current directions for use. These risks could be mitigated by implementation of use restrictions or a restricted materials designation, however these mitigation options pose challenges and limitations to implementation and risk reduction.

DPR is seeking public comment and requesting that stakeholders provide any relevant information and commentary on the options for mitigating fipronil's aquatic and human health risks outlined above, as well as any other potential mitigation options. This feedback will help inform DPR's next steps. All relevant feedback is welcome; feedback may include, but is not limited to, the following topics:

- Voluntary stewardship and consumer education – Timing, types, breadth, potential implementation options, how it could serve as a complement to and support various mitigation options
- Use restrictions – DPR's analysis, other possible use restrictions, data/information related to impact of restriction to product efficacy and pest resistance, practical implications and likelihood of success from proposed use restrictions
- Restricted materials designation – DPR's analysis, practical impacts of the designation and how the designation could be implemented successfully

- Additional information or data about consumer sales and use/behaviors
- Chemical and non-chemical alternatives to fipronil pet products
- Other mitigation options

Comments will be accepted for the next 60 days, until 11/16/2026.

CC:

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Appendix A – Potential acute and chronic risk from fipronil pet spot-on products

Table A-1. PREM recommendations on registration decisions for fipronil spot-on products by pet type and weight category.⁵

Application Rate Category	Acute RQ (LOC = 0.5) * Minimum DPR LC₅₀	Chronic RQ (LOC = 1.0) * Minimum DPR NOEC
Extra Large Dog	Not Support (1.13)	Not Support (20.7)
Large Dog	Not Support (0.76)	Not Support (13.8)
Medium Dog	Support (0.38)	Not Support (6.8)
Small Dog	Support (0.19)	Not Support (3.5)
Median Rate for All Dogs **	Not Support (0.56)	Not Support (10.3)
Cat	Support (0.04)	Support (0.78)

Table Notes:

* Model-predicted risk quotients (RQs) are shown in parentheses. Threshold RQs exceeding the level of concern (LOC) are 0.5 for acute toxicity and 1.0 for chronic toxicity.

** The median application rate across all dog weight categories serves as a standardized heuristic for calculating RQs for fipronil in dog spot-on formulations. Cat spot-on products are formulated with a single application rate applicable to all cat sizes.

For registration evaluation of urban products, PREM uses the minimum DPR-approved ecotoxicity value as the toxicity endpoint. Among the approved values, the lowest acute LC₅₀/EC₅₀ in water column is 140 ng/L (Mysid shrimp, 96hour exposure), and the lowest chronic NOEC is 7.7 ng/L (Mysid shrimp, 28-day exposure). Toxicity to sediment dwelling species was not evaluated because fipronil is highly soluble in water (Koc < 1000 L/kg[OC]) and has low affinity for sediment.

PREM-estimated RQs for cat products were scaled by 0.33 to reflect four annual baths (vs. 12 originally assumed in model development), corresponding to an estimated 7% wash-off per application. Cat wash-off data are unavailable. The 7% rate is comparable to the lower bound of percent wash-off from treated dogs considering bathing, hand washing after petting, and bed washing (Perkins et al., 2024), whereas the 21% wash-off used in PREM for dog topical applications represents the upper bound reported in available studies (Teerlink et al. 2017).

⁵ PREM recommendations on registration decisions are not determinative on whether the product will be registered. DPR considers other factors in its registration determination, including, but not limited to, likely use patterns and state-specific public health and environmental concerns.

Appendix B – PREM Validation

The PREM was validated using available monitoring datasets to assess its performance in capturing the worst-case exposures as a protective registration evaluation tool before being applied to evaluate potential risks and mitigation effectiveness for fipronil dog spot-on products.

First, the sum of estimated environmental concentrations (EECs) for the primary fipronil use patterns contributing to surface water contamination (Table B-1) was compared with monitoring data from California receiving waters (excluding storm drains and agricultural ditches) in DPR's SURF database (Zhang et al., 2019). The evaluated uses included dog spot-on applications and urban outdoor perimeter treatments following the 2019 label change. These uses account for over 99% of statewide fipronil sales (DPR, 2025a) and are associated with high transport potential to surface water. Cat spot-on products, pet sprays, termite soil applications, foams, gel baits, and granules were excluded due to low sales volumes or low likelihood of runoff or down-the-drain (DtD) transport. Monitoring data collected after 2019 were used because the label change took effect that year. Second, PREM-predicted wastewater effluent concentrations attributable to dog spot-on uses were compared with DPR wastewater monitoring data (DPR, 2025a).

For a screening level tool, model performance was considered acceptable when EECs were within one order of magnitude greater than the upper percentiles of monitoring data (Xie et al., 2018; Xie et al., 2025; Luo et al., 2023), corresponding to a predicted-to-observed (P/O) ratio between 1 and 10. Table B-2 summarizes the P/O ratios for comparisons with the 90th and 95th percentiles for both surface water and wastewater effluent. All P/O ratios fell within the 1–10 range, except for the comparison with the 90th percentile of surface water concentrations using all SURF data (P/O = 12.1), indicating a modest overprediction. Overall, PREM predictions are consistent with expectations for a screening-level, protective registration evaluation tool.

Table B-1. PREM input and output for model validation.

Use Pattern	Application Rate	Application Interval (days)	Number of Application per Year	Concentration in Effluent (ng/L)	Daily Average EEC in Water Column (ng/L)
Dog Spot-on (Median Rate)	2.13E+05 (µg AI/dog)	30	12	375 *	79
Urban Outdoor Perimeter (DPR label change)	0.19 (kg AI/ha)	60	4 (March 1st to October 31st)	NA	87 (Adoption Rate = 0.263) **

Table notes:

* Concentration in effluent from dog spot-on products was estimated as $(2.13E+05 \mu\text{g}/\text{dog} * 0.07 * 0.21 * 0.8697 * (1/30))/242 \text{ L} = 0.375 \mu\text{g}/\text{L}$, where 0.07 is the neighborhood dilution factor for dog topical products, 0.21 is the wash-off coefficient, 0.8697 is the wastewater delivery factor estimated from the EPI Suite, and 30 is the reapplication interval, following methodology presented in Table 5 of Xie and Luo, 2022.

** Model input for urban outdoor perimeter applications is derived from Budd and Luo (2016).

Table B-2. Comparison between PREM outputs and monitoring data, indicated by P/O ratios.

Compartment	PREM-Estimated Concentration (ng/L) **	Monitoring Concentration (ng/L)			P/O (P95) ***	P/O (P90) ***
		Max	P95 ***	P90 ***		
Wastewater Effluent *	375	411	52.13	43.8	7.2	8.6
Surface Water (DPR data only) *	166	173	46.7	27	3.6	6.2
Surface Water (All SURF data) *	166	482	30	13.7	5.5	12.1

Table notes:

* Wastewater effluent monitoring data were obtained from DPR, 2025a. Surface water monitoring concentrations were obtained from DPR studies only (2019-2023) and all available data in SURF (2019-2025), including datasets reported by DPR, CEDEN, USGS NWIS, and U.S. EPA STORET (retrieved March 11, 2026).

** PREM-estimated concentration in surface water is the sum of EECs from dog spot-on applications and urban outdoor perimeter treatments (Table B-1).

*** P95 and P90 represent the 95th and 90th percentiles, respectively, of monitoring concentrations of fipronil.

Appendix C – 303(d) Listed Waterbodies for Fiproles

The term “fiproles” represents the parent fipronil and its major degradate compounds.

Table C-1. California 303(d) listed waterbodies for fipronil and/or fipronil sulfone with associated wastewater discharge.

Regional Water Board	Waterbody Name	Listed Pollutant	WWTP Discharge
2	Castro Valley Creek	Fipronil	NA
2	Nathanson Creek subwatershed	Fipronil	NA
2	Petaluma River	Fipronil	Ellis Creek WRF
3	Salinas River (lower, estuary to near Gonzales Rd crossing)	Fipronil	NA
4	Ballona Creek	Fipronil	NA
4	Bouquet Canyon Creek (below Bouquet Reservoir)	Fipronil, Sulfone	NA
4	Los Angeles River Reach 1 (Estuary to Carson Street)	Fipronil	Glendale WRP*, Burbank WRP*, Tillman WRP*
4	Santa Clara River Reach 5 (Blue Cut gaging station to West Pier Hwy 99 Bridge)	Fipronil	Saugus WRP, Valencia WRP
5	Dry Creek	Fipronil	Dry Creek WWTP
5	Pleasant Grove Creek	Fipronil	Pleasant Grove WWTP
5	Pleasant Grove Creek, unnamed northern tributary (from Greywood Circle to confluence with Pleasant Grove Creek)	Fipronil, Sulfone	Pleasant Grove WWTP
5	Pleasant Grove Creek, unnamed northern tributary (from Mt Tamalpais Dr to confluence with Pleasant Grove Creek)	Fipronil, Sulfone	Pleasant Grove WWTP
5	Sacramento River (in Delta Waterways)	Fipronil	Sac City Combined, Sacramento Regional, Northwest WWTF, Beach WWTF
5	Unnamed Tributary to Alder Creek	Fipronil, Sulfone	NA
5	Arcade Creek	Fipronil sulfone	NA

*Discharge very upstream of listed waterbody. NA = no WWTP discharge present in listed waterway.

Appendix D – Modeling Aquatic Risk Mitigation Options

The validated PREM was further used to evaluate potential mitigation measures to reduce predicted aquatic risks associated with fipronil dog spot-on products. Mitigation options assessed include adjusting one or more of the following:

- Reducing the number of applications per year
- A “no-bathing” restriction period of one week (7 days) post application
- Reducing application rates

Table D-1. Proposed mitigation options needed to achieve target percent reduction based on PREM predictions.

Target % Reduction	Option	Number of Applications per Year	No-Bathing 7-day Post Application	Reducing Application Rate	PREM-Predicted % Reduction
71.6%	1	3	No	No	75%
	2	4	Yes	No	75%
	3	5	Yes	14%	73%
	4	6	Yes	28%	73%

The target % reduction was calculated using equation 1.

$$\text{Target \% Reduction} = \frac{P90(C_{RW}) - \text{Min}(BM)}{P90(C_{RW})} \quad [1]$$

where $P90(C_{RW})$ is the 90th percentile of fipronil concentrations in wastewater-receiving streams, and $\text{Min}(BM)$ is the minimum U.S. EPA aquatic life benchmark, which is the chronic freshwater benchmark.

Because comprehensive receiving-stream monitoring data are not available for most WWTPs, $P90(C_{RW})$ was estimated using DPR wastewater effluent monitoring data and dilution factors for California wastewater-receiving streams, obtained from a DPR-funded research contract (equation 2).

$$P90(C_{RW}) = \frac{P90(C_{eff})}{P10(DF)} \quad [2]$$

where $P90(C_{eff})$ is the 90th percentile of fipronil concentrations measured in DPR's wastewater effluent dataset (241 samples from 33 WWTPs across 10 California counties collected between June 2019 and May 2024; DPR, 2025a), and $P10(DF)$ is the 10th percentile of dilution factors, protecting 90% of wastewater-receiving streams statewide. Dilution factors were calculated using equation 3 for 164 outfalls of 160 WWTPs that discharge to surface water in California using National Pollutant Discharge Elimination System (NPDES) permitted flow and estimated annual mean receiving stream flows from NHDPlus V2 (DPR, 2023).

$$DF = \frac{Q_r + Q_w}{Q_w} \quad [3]$$

where Q_w is the NPDES permitted flow and Q_r is the receiving-water flow.

Numbers used in calculation of target % reduction in Table D-1.

$Min(BM) = 11 \text{ ng/L}$

$P90(C_{eff}) = 43.8 \text{ ng/L}$ (DPR, 2025a)

$P10(DF) = 1.132$ (DPR, 2023)

Appendix E – Analysis of Seasonal Variation in Fipronil Concentrations in Wastewater

A potential mitigation strategy could involve restricting product applications to the period of highest flea population activity. In California, that period generally occurs during the warmer months (April-October) (Self et al., 2024). The effect of implementing this strategy on wastewater fipronil concentrations is unknown. One question surrounding restrictive application periods is whether or not seasonal variability in influent concentrations currently exists. To answer this question, DPR staff analyzed monitoring data from DPR's wastewater monitoring program (DPR, 2025b). DPR influent data collected 2019-2025 was grouped according to sampling date into four seasons: Fall=Sep-Nov, Winter=Dec-Feb, Spring=Mar-May, and Summer=Jun-Aug. There is an observed seasonality in fipronil influent concentrations (Figure E-1). Seasonal median concentrations are significantly different for all comparisons except Summer vs. Fall (Table E-1). This indicates a seasonal trend in fipronil entering the waste stream does exist, with higher concentrations during warmer months when flea populations are highest. Observed seasonal variations in fipronil concentrations complicates proposed mitigation actions, as restricting use to the periods of higher flea activity would not alleviate the peak fipronil concentrations present in effluent.

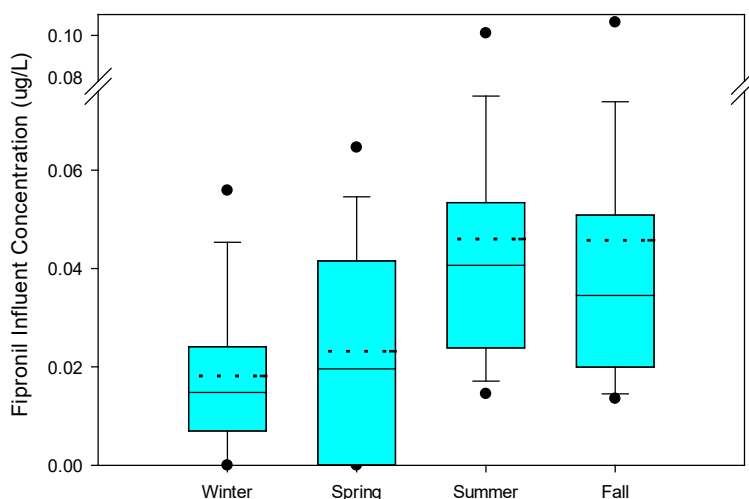


Figure E-1. Fipronil concentrations in influent by season (Fall=Sep-Nov, Winter=Dec-Feb, Spring=Mar-May, Summer=Jun-Aug). For visualization purposes, non-detects (ND) were set to 0.

Table E-1. Summary statistics for fipronil in wastewater influent.

Season	N	DF (%)	Mean (µg/L)	Median (µg/L)	P95 (µg/L)
Summer	64	92	0.046	0.041	0.094
Fall	69	72	0.047	0.035	0.095
Spring	73	48	0.030	0.023	0.064
Winter	88	30	0.024	< 0.016	0.053

Table Notes: Summary statistics were determined using nonparametric Kaplan Meier evaluation.
P95 = 95th percentile. N = number of samples. DF = detection frequency.

Appendix F – Fipronil Pet Product Information

Table F-1. Registrants of fipronil pet products by formulation and pet type (as of April 14, 2026).

Formulation	Spray	Spot-on	Spot-on	
Registrant	Both	Cat	Dog	Total
APEX ANIMAL HEALTH, LLC		1	1	2
ASPEN VETERINARY RESOURCES, LTD.		1	1	2
BOEHRINGER INGELHEIM ANIMAL HEALTH USA INC.	1	2	3	6
CAP IM SUPPLY, INC.		1	1	2
CAP SUPPLY, INC.		1	1	2
CEVA ANIMAL HEALTH, LLC		1		1
CONTROL SOLUTIONS, INC.	1			1
HORIZON VALLEY GENERICS, INC.		1	1	2
MERIDIAN ANIMAL HEALTH		2	2	4
NEW THINKING TECHNOLOGY INC		1	1	2
NUTRI-VET WELLNESS LLC		1	1	2
ONGUARD PET PRODUCTS, LLC		1	1	2
PET FRIENDLY DIRECT, LLC		1		1
PETMED EXPRESS, INC.		1	1	2
PROMIKA, LLC		1		1
SERGEANT'S PET CARE PRODUCTS, LLC		5	5	10
TEVRA BRANDS, LLC		2	2	4
THE HARTZ MOUNTAIN CORPORATION		2	2	4
THE KROGER COMPANY		1	1	2
VIRBAC AH, INC.		1	2	3

As of August 24, 2026, six additional topical pet products containing fipronil have been registered (EPA Registration Numbers: 2517-134-ZF-84742, 2517-135-ZE-84742, 2517-142-ZB-84742, 2517-145-ZB-84742, 91300-5-AA, 91300-6-AA).

Table F-2. Registered pet products containing fipronil (as of April 14, 2026).

Registrant	Product Name	REGNO	Formulation	Pet Type	# Labels	# Weight Classes
SERGEANT'S PET CARE PRODUCTS, LLC	PETARMOR FOR CATS	2517-137-ZC	Spot-on	Cat	2	1
SERGEANT'S PET CARE PRODUCTS, LLC	SENTRY FIPROGUARD FOR CATS	2517-137-AA	Spot-on	Cat	1	1
SERGEANT'S PET CARE PRODUCTS, LLC	PETARMOR FOR DOGS	2517-136-ZB	Spot-on	Dog	8	4
SERGEANT'S PET CARE PRODUCTS, LLC	SENTRY FIPROGUARD FOR DOGS	2517-136-AA	Spot-on	Dog	4	4
SERGEANT'S PET CARE PRODUCTS, LLC	PETACTION PRO FOR CATS	2517-135-ZD	Spot-on	Cat	3	1
SERGEANT'S PET CARE PRODUCTS, LLC	PETARMOR PLUS FOR CATS	2517-135-ZB	Spot-on	Cat	1	1
SERGEANT'S PET CARE PRODUCTS, LLC	SENTRY FIPROGUARD PLUS FOR CATS	2517-135-ZA	Spot-on	Cat	1	1
SERGEANT'S PET CARE PRODUCTS, LLC	PETACTION PRO FOR DOGS	2517-134-ZD	Spot-on	Dog	12	4
SERGEANT'S PET CARE PRODUCTS, LLC	PETARMOR PLUS FOR DOGS	2517-134-ZB	Spot-on	Dog	12	4
SERGEANT'S PET CARE PRODUCTS, LLC	SENTRY FIPROGUARD PLUS FOR DOGS	2517-134-AA	Spot-on	Dog	4	4
THE HARTZ MOUNTAIN CORPORATION	HARTZ MEGASHIELD TOPICAL FOR DOGS	2596-165-AA-7689	Spot-on	Dog	4	4
THE HARTZ MOUNTAIN CORPORATION	HARTZ MEGASHIELD TOPICAL FOR CATS	2596-166-AA-7689	Spot-on	Cat	1	1
CEVA ANIMAL HEALTH, LLC	CATEGO FOR CATS	83399-15-AA	Spot-on	Cat	1	1
BOEHRINGER INGELHEIM ANIMAL HEALTH USA INC.	FRONTLINE SHIELD FOR DOGS	65331-9-AA	Spot-on	Dog	5	5
BOEHRINGER INGELHEIM ANIMAL HEALTH USA INC.	FRONTLINE PLUS FOR DOGS	65331-5-ZB	Spot-on	Dog	4	4
BOEHRINGER INGELHEIM ANIMAL HEALTH USA INC.	FRONTLINE PLUS FOR CATS	65331-4-ZB	Spot-on	Cat	1	1
BOEHRINGER INGELHEIM ANIMAL HEALTH USA INC.	FRONTLINE SPRAY	65331-1-ZB	Spray	Both	2	1
BOEHRINGER INGELHEIM ANIMAL HEALTH USA INC.	FRONTLINE GOLD FOR CATS	2596-179-ZA-65331	Spot-on	Cat	1	1
BOEHRINGER INGELHEIM ANIMAL HEALTH USA INC.	FRONTLINE GOLD FOR DOGS	2596-178-ZA-65331	Spot-on	Dog	8	4
MERIDIAN ANIMAL HEALTH	FROM THE MAKERS OF CAPSTAR (NITENPYRAM) NEXTSTAR FLEA & TICK TOPICAL FOR CATS	2517-145-ZA-84742	Spot-on	Cat	2	1
MERIDIAN ANIMAL HEALTH	FROM THE MAKERS OF CAPSTAR (NITENPYRAM) NEXTSTAR FLEA & TICK TOPICAL FOR DOGS	2517-142-AA-84742	Spot-on	Dog	8	4

Registrant	Product Name	REGNO	Formulation	Pet Type	# Labels	# Weight Classes
MERIDIAN ANIMAL HEALTH	AMAZON BASICS FLEA & TICK TOPICAL FOR CATS	2517-135-ZD-84742	Spot-on	Cat	2	1
MERIDIAN ANIMAL HEALTH	AMAZON BASICS FLEA & TICK TOPICAL FOR DOGS	2517-134-ZE-84742	Spot-on	Dog	8	4
THE KROGER COMPANY	LUVSOME PLUS FLEA & TICK FOR CATS	2517-135-AA-65948	Spot-on	Cat	1	1
THE KROGER COMPANY	LUVSOME PLUS FLEA & TICK FOR DOGS	2517-134-AA-65948	Spot-on	Dog	4	4
APEX ANIMAL HEALTH, LLC	APEX PLUS FOR CATS	53883-352-AA-103215	Spot-on	Cat	2	1
APEX ANIMAL HEALTH, LLC	APEX PLUS FOR DOGS	53883-351-AA-103215	Spot-on	Dog	8	4
ASPEN VETERINARY RESOURCES, LTD.	STEELCOAT PLUS FOR CATS	88052-16-AA-40940	Spot-on	Cat	1	1
ASPEN VETERINARY RESOURCES, LTD.	STEELCOAT PLUS FOR DOGS	88052-15-AA-40940	Spot-on	Dog	4	4
VIRBAC AH, INC.	EFFITIX PLUS TOPICAL SOLUTION FOR DOGS	2382-192-AA	Spot-on	Dog	4	5
VIRBAC AH, INC.	EFFIPRO PLUS TOPICAL SOLUTION FOR DOGS	2382-189-AA	Spot-on	Dog	4	4
VIRBAC AH, INC.	EFFIPRO PLUS TOPICAL SOLUTION FOR CATS	2382-188-AA	Spot-on	Cat	1	1
CONTROL SOLUTIONS, INC.	MARTIN'S FLEA PLUS IGR TRIGGER SPRAY	87093-8-ZB-53883	Spray	Both	1	1
THE HARTZ MOUNTAIN CORPORATION	PET DEFENDER PLUS FOR CATS	2596-166-ZA	Spot-on	Cat	1	1
THE HARTZ MOUNTAIN CORPORATION	PET DEFENDER PLUS FOR DOGS	2596-165-ZA	Spot-on	Dog	4	4
PETMED EXPRESS, INC.	FLEA 5X PLUS FOR CATS	2517-135-ZA-88832	Spot-on	Cat	1	1
PETMED EXPRESS, INC.	FLEA 5X PLUS FOR DOGS	2517-134-ZA-88832	Spot-on	Dog	4	4
HORIZON VALLEY GENERICS, INC.	MASTER LABEL - C712.0 FOR CATS	88052-9-ML	Spot-on	Cat	1	1
HORIZON VALLEY GENERICS, INC.	MASTER LABEL - C712.0 FOR DOGS	88052-8-ML	Spot-on	Dog	1	4
TEVRA BRANDS, LLC	VETALITY FIRSTECT PLUS FOR CATS	88052-16-ZA-92413	Spot-on	Cat	1	1
TEVRA BRANDS, LLC	TEVRAPET FIRSTACT PLUS FOR CATS	88052-16-AA-92413	Spot-on	Cat	1	1
TEVRA BRANDS, LLC	VETALITY FIRSTECT PLUS FOR DOGS	88052-15-ZA-92413	Spot-on	Dog	4	4
TEVRA BRANDS, LLC	TEVRAPET FIRSTACT PLUS FOR DOGS	88052-15-AA-92413	Spot-on	Dog	4	4
PROMIKA, LLC	SHIELDTEC FOR CATS	53883-359-AA-91300	Spot-on	Cat	1	1
CAP IM SUPPLY, INC.	COVETRUS PARAMONTHLY PLUS FOR CATS	2596-166-AA-91384	Spot-on	Cat	1	1

Registrant	Product Name	REGNO	Formulation	Pet Type	# Labels	# Weight Classes
CAP IM SUPPLY, INC.	COVETRUS PARAMONTHLY PLUS FOR DOGS	2596-165-AA-91384	Spot-on	Dog	4	4
CAP SUPPLY, INC.	PETPREVEA PLUS FOR CATS	2596-166-ZD-91019	Spot-on	Cat	2	1
CAP SUPPLY, INC.	PETPREVEA PLUS FOR DOGS	2596-165-ZD-91019	Spot-on	Dog	8	4
PET FRIENDLY DIRECT, LLC	PAWS PLUS FOR CATS	88052-16-AA-93176	Spot-on	Cat	1	1
ONGUARD PET PRODUCTS, LLC	ONGUARD PLUS FOR CATS FLEA & TICK	2517-135-AA-93374	Spot-on	Cat	2	1
ONGUARD PET PRODUCTS, LLC	ONGUARD PLUS FOR DOGS FLEA & TICK	2517-134-AA-93374	Spot-on	Dog	8	4
NUTRI-VET WELLNESS LLC	NUTRI-VET GUARD+ FOR DOGS	53883-351-AA-82530	Spot-on	Dog	4	4
NUTRI-VET WELLNESS LLC	NUTRI-VET GUARD+ FOR CATS	53883-352-AA-82530	Spot-on	Cat	1	1
NEW THINKING TECHNOLOGY INC	ADVANLLENT SQUEEZE ON FOR DOGS	93207-3-ZA	Spot-on	Dog	3	3
NEW THINKING TECHNOLOGY INC	ADVANLLENT SQUEEZE ON FOR CATS	93207-4-ZA	Spot-on	Cat	1	1

Modeled risk and mitigation possibilities in this memo based on fifty-five products listed in this table. As of August 24, 2026, six additional topical pet products containing fipronil have been registered (EPA Registration Numbers: 2517-134-ZF-84742, 2517-135-ZE-84742, 2517-142-ZB-84742, 2517-145-ZB-84742, 91300-5-AA, 91300-6-AA)

Appendix G – References

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