ENVIRONMENTAL ASSESSMENT

1. Date: December 29, 2022

2. Name of Submitter: Safe Foods Corporation/LPR Technologies

3. Correspondence Address:

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4. Description of the Proposed Action

A. Requested Action

The action requested in this notification is to provide for the use of the Food Contact Substance (FCS), which is an aqueous mixture of peroxyacetic acid (PAA), hydrogen peroxide, acetic acid, 1-hydroxyethylidene-1,1-diphosphonic acid (HEDP) and/or dipicolinic acid (DPA), and optionally, sulfuric acid, as an antimicrobial agent to be used:

(1) At concentrations up to 2000 ppm peroxyacetic acid, 1333 ppm hydrogen peroxide, 133 ppm HEDP, and/or 6.5 ppm DPA for use in process water applied as a wash, spray, dip, rinse, chiller water, low-temperature (less than 40 °F) immersion bath, or scald water for whole or cut poultry carcasses, parts, trim, and organs.
(2) At concentrations up to 1800 ppm peroxyacetic acid, 1200 ppm hydrogen peroxide, 120 ppm HEDP, and/or 5.9 ppm DPA for use in process water or ice used in washing, rinsing, or cooling whole or cut meat carcasses, parts, trim, and organs.
(3) At concentrations up to 230 ppm peroxyacetic acid, 153 ppm hydrogen peroxide, 15 ppm HEDP, and/or 0.8 ppm DPA for use in process water or ice used during commercial preparation of fish and seafood.
(4) At concentrations up to 350 ppm peroxyacetic acid, 233 ppm hydrogen peroxide, 23 ppm HEDP, and/or 1.2 ppm DPA for use in process water used in washing or chilling fruits and vegetables in food processing facilities.
(5) At concentrations up to 2000 ppm peroxyacetic acid, 1333 ppm hydrogen peroxide, 120 ppm HEDP, and/or 6.5 ppm DPA for use in process water used in washing shell eggs.

Mixtures of these substances have previously been approved for the same uses, with several Food Contact Notifications (FCNs) (No. 1094, 1477, 1522, 1641, 1654, 1662, 1823,1886, 1936, 1960, 2011, 2036, and 2046) permitting the use of the substances at concentrations at or above the levels proposed above.

B. Need for Action

The antimicrobial agent reduces or inhibits the growth of pathogenic and non-pathogenic microorganisms that may be present on and in food to provide safer foods for consumers.

The requested action to expand the currently approved uses of the FCS is needed to address current and future needs of food processors and governmental agencies to improve food safety. Use of the FCS provides more options for antimicrobial interventions. For example, the use of peroxyacetic acid at higher concentrations for relatively short periods of time, and in smaller total volumes, enhances the capacity of the food industry to improve processing techniques, such as providing more flexibility in terms of time, concentrations, and application method (spray vs. immersion) to better control food pathogens. Other authorizations, including those listed in Section 4.A, for the FCS and uses notified herein have allowed processing plants more flexibility in using and managing microbial interventions across entire production processes. The current FCN is needed to allow market access for the Notifier identified herein.

The use of HEDP and DPA improve stability of concentrated peroxyacetic acid formulations during storage until they are diluted with water.

C. Locations of Use/Disposal

The antimicrobial agent is intended for use in poultry, meat, fish and seafood, fruit and vegetable, and egg processing plants throughout the United States. The FCS also may be used in brines, marinades and sauces. After use, the FCS will be disposed of with processing plant wastewater according to National Pollutant Discharge Elimination System (NPDES) regulations. For processing plants that hold a NPDES permit (i.e., direct dischargers), the FCS-containing wastewater will be treated on-site before direct discharge to surface waters. For processing plants without such NPDES permits (i.e., indirect dischargers), the FCS-containing wastewater would travel through the sanitary sewer system into Publicly Owned Treatment Works (POTWs) for standard wastewater treatment processes before movement into aquatic environments. It is expected that process water not containing the FCS will be used in plants for activities such as cleaning and sanitation, resulting in significant dilution of the FCS into the total water effluent. Wastewater from fishing vessels is expected to be disposed in the ocean.

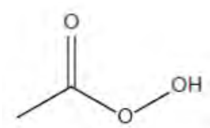
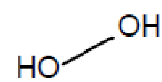
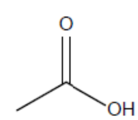
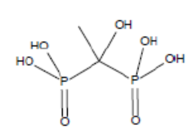
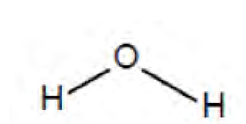
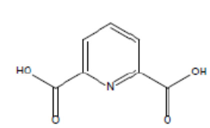
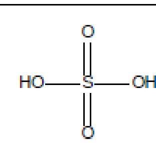
As a conservative approach, it can be assumed that wastewater will be treated on-site before discharge to surface water pursuant to a NPDES permit. We have also estimated maximum potential concentrations in soil from application of sludge from wastewater treatment facilities to soil.

5. Identification of Substances that are the Subject of the Proposed Action

The Food Contact Substance is an aqueous mixture of peroxyacetic acid, hydrogen peroxide, acetic acid, 1-hydroxyethylidene-1,1-diphosphonic acid and/or dipicolinic acid, and optionally, sulfuric acid. PAA formation is the result of an equilibrium reaction between acetic acid and hydrogen peroxide. The FCS is supplied in concentrated form and is diluted at the processing plant to achieve the desired level of PAA needed to address the microbial load.

The descriptions, chemical formulae, structures, and molecular weights of the components are described in Table 1 below:

Table 1: Chemical Identity of Food Contact Substance Components

Component	CAS Number	Molecular Weight	Molecular Formula	Molecular Structure
Peroxyacetic acid	79-21-0	76.05 g/mol	$C_2H_4O_3$	
Hydrogen peroxide	7722-84-1	34.0147 g/mol	H_2O_2	
Acetic acid	64-19-7	60.05 g/mol	$C_2H_4O_2$	
1-hydroxyethylidene-1,1-diphosphonic acid	2809-21-4	206.028 g/mol	$C_2H_8O_7P_2$	
Water	7732-18-5	18.015 g/mol	H_2O	
Dipicolinic acid	499-83-2	167.12 g/mol	$C_7H_5NO_4$	
Sulfuric acid	7664-93-9	98.08 g/mol	H_2SO_4	

6. Introduction of Substances into the Environment

A. Introduction of Substances into the Environment as a Result of Manufacture

As provided in 21 CFR 25.40 (a), an environmental assessment should focus on relevant environmental issues relating to the use and disposal from use, rather than the production, of FDA-regulated articles.

The FCS is manufactured in plants which meet all applicable federal, state and local environmental regulations. Notifier asserts that no extraordinary circumstances apply to the manufacture of the FCS including situations where: 1). unique emission circumstances are not adequately addressed by general or specific emission requirements (including occupational) promulgated by Federal, State or local environmental agencies and the emissions may harm the environment; 2). a proposed action threatens a violation of Federal, State or local environmental laws or requirements; and 3). production associated with a proposed action may adversely affect a species or the critical habitat of a species determined under the Endangered Species of Wild Fauna and Flora to be endangered or threatened, or wild fauna or flora that are entitled to special protection under some other Federal law.

B. Introduction of Substances into the Environment as a Result of Use/Disposal

The FCS is supplied in concentrated form and is diluted at the processing plant. When diluted for use, the target levels of PAA in the process water for use will vary according to microbial load and type of application. The maximum at-use concentration of PAA, hydrogen peroxide (H_2O_2), HEDP and dipicolinic acid (DPA) for each application will be as follows:

Application	PAA	H_2O_2	HEDP	DPA
1). Poultry	2000 ppm	1333 ppm	133 ppm	6.5 ppm
2). Meat	1800 ppm	1200 ppm	120 ppm	5.9 ppm
3). Fish and seafood	230 ppm	153 ppm	15 ppm	0.8 ppm
4). Fruits and vegetables	350 ppm	233 ppm	23 ppm	1.2 ppm
5). Shell eggs	2000 ppm	1333 ppm	120 ppm	6.5 ppm

Treatment of the process water at the on-site wastewater treatment plant or at the POTW is expected to result in complete degradation of peroxyacetic acid, hydrogen peroxide and acetic acid, based on the half-life of these substances (described in detail in section 7 of this EA). Specifically, peroxyacetic acid will break down into oxygen and acetic acid, and hydrogen peroxide will break down into oxygen and water. Therefore, these substances are not expected to be introduced into the environment in any significant extent as a result of the proposed use of the FCS. Consequently, the remainder of this section will consider only the environmental introduction of HEDP and DPA.

Because it is difficult to establish water usage levels, we assume, in the very worst-case, that all of the water used in a plant is treated with the FCS at the maximum notified use level concentration of 2000 ppm PAA, 1333 ppm H_2O_2, 133 ppm HEDP and 6.5 ppm DPA for our analysis of the environmental introductions and impacts.

7. Fate of Substances Released into the Environment

As previously mentioned, treatment of the process water at the on-site wastewater treatment plant or at the POTW is expected to result in complete degradation of peroxyacetic acid, hydrogen peroxide and acetic acid. PAA and hydrogen peroxide rapidly degrade upon contact with organic matter, transition metals, and upon exposure to sunlight. According to the European Center for Ecotoxicology and Toxicology of Chemicals (ECETOC), the half-life of PAA in buffered solutions was 63 hours at pH 7 for a 748 ppm solution, and 48 hours at pH 7 for a 95 ppm solution. [1] The half-life of hydrogen peroxide in natural rivers ranged from 2.5 days when initial concentration was 10,000 ppm, to 20.1 days when initial concentration decreased to 100 ppm. [2] Biodegradability studies of acetic acid showed 99% degradation in 7 days under anaerobic conditions. [3] Acetic acid is not expected to concentrate in the waste water discharged to POTW. In wastewater, sulfuric acid will completely dissociate into sulfate ions and hydrated protons, neither of which are a toxicological or environmental concern at the proposed use levels. [4] Therefore, peroxyacetic acid, hydrogen peroxide, acetic acid and sulfuric acid are not expected to be introduced into the environment to any significant extent as a result of the proposed use of the FCS. The remainder of this EA will therefore consider only the environmental introduction of HEDP and DPA.

<u>HEDP:</u>
The 2004 Human and Environmental Risk Assessment (HERA) reports that decomposition of HEDP contained in the discharged wastewater occurs at a moderately slow pace, 33% in 28 days. [5] HEDP that is removed via sedimentation or filtration slowly degrades into carbon dioxide, water and phosphates. Phosphate anions are strongly bound to organic matter and soil particles, and phosphate is a required macronutrient of plants. The HERA report estimates a half-life of HEDP in soil of 373 days. Therefore, any aquatic or soil biodegradation of HEDP is not expected to lower the estimated EEC for HEDP.

The 2004 HERA publication on phosphonate indicates that 80-90% can be expected to adsorb to wastewater sludge. Therefore, the sludge partition EICs of HEDP are calculated by multiplying the stated HEDP use level concentration by 80% (use level x 0.8). Multiplying the use level by 20% (use level x 0.2) provides the HEDP concentration remaining in wastewater. The expected environmental concentrations (EECs) were calculated using a conservative 10-fold dilution factor for discharge to surface waters of the effluent from an onsite treatment facility or POTW, as determined by Rapaport (Rapaport 1988).[6] A summary of these calculations is shown below.

Application	**HEDP**	**EEC_{sludge} and EIC_{sludge} [a]**	**EIC_{water}**	**EEC_{water} [b]**
Worst-case scenario: Application(s) having the Highest use-level Concentration	133	106.4	26.6	2.66

[a] EIC_{sludge} = HEDP x 80%

[b] EEC_{water} = (HEDP x 20%) ÷ 10 dilution factor)

DPA:

Studies of the biodegradability of dipicolinic acid have shown that it is biodegradable in both aerobic and anaerobic aquatic environments, [7, 8, 9] and in aerobic and anaerobic soil environments.[10] Earlier studies demonstrated that the gram-negative bacteria *Achromobacter sp.* oxidized dipicolinic acid (pyridine-2,6-dicarboxylic acid) into carbon dioxide, ammonia and water.[11] In a study of phthalate-degrading bacteria isolated from marine sediment, degradation was reported to occur via metabolism of pyridine dicarboxylic acids. In addition, a *Bacillus brevis* strain was reported to grow on 2,6-dipicolinic acid (2,6-DPA), producing 2,3-dihydroxypicolinic acid (2,3-DHPA), which degrades further upon exposure to sunlight.[8] Therefore, in illuminated aquatic environments, the coupled bio- and photodegradative mechanisms are expected to contribute to degradation of pyridinedicarboxylic acids. In an anaerobic environment, the transformation of 2,6-dipicolinic acid by a defined coculture of two bacteria from marine sediments was studied.[9] The result was the 2-6-DPA transformation to propionic acid, acetic acid, carbon dioxide and ammonium.

DPA is highly soluble in water, with an estimated solubility of 5000 mg/L, and an octanol-water partition coefficient of 0.57. Therefore, based on the high solubility of DPA in water, it is expected to remain in solution and not be adsorbed to sludge. Based on the biodegradability information, it is also expected that DPA will be readily biodegraded during treatment at POTWs and on-site treatment facilities.

By using the worst-case scenario (at-use concentration) for the environmental introduction of DPA, and a 10% dilution factor to calculate the estimated environmental concentration (EEC), the resulting EIC and EEC values for DPA are summarized below:

Application	DPA (ppm)	EEC_{sludge} and EIC_{sludge}	EIC_{water} [a]	EEC_{water} [b]
Worst-case scenario: Application(s) having the Highest use-level Concentration	6.5	-	6.5	0.65

[a] EIC_{water} = DPA (100%)
[b] EEC_{water} = EIC_{water} ÷ 10 dilution factor)

8. Environmental Effects of Released Substances

Terrestrial Toxicity
HEDP: According to the 2004 HERA report, HEDP in sludge is not expected to have any adverse environmental impact based on toxicity endpoints for terrestrial organisms. Specifically, HEDP shows no toxicity to terrestrial organisms (plants, earthworms, worms in soil, etc.) at levels up to 1000 mg/kg soil dry weight (No Observed Effect Concentration; NOEC). Therefore, there is no toxicity expected from land application of sludge containing 106.4 ppm HEDP.

DPA: As noted in Section 7 above, DPA is highly soluble in water, and little, if any, is expected to be adsorbed to sludge. Therefore, terrestrial release of DPA from the intended use of the FCS is expected to be negligible and no toxicity concerns are expected.

Aquatic Toxicity
HEDP: The 2004 HERA study demonstrates that toxic effects of HEDP result from chelation of nutrients, rather than direct toxicity to aquatic organisms. Chelation is not toxicologically relevant in the evaluation of the toxic effects of HEDP because eutrophication, not nutrient depletion, has been demonstrated as the controlling toxicological mode when evaluating wastewater discharges from food processing facilities. Jaworska et al., [12] and the HERA 2004 study on phosphonates have summarized the aquatic toxicity data for HEDP as shown in the table below:

Environmental Toxicity Data for HEDP:

Exposure Duration	Species	Endpoint	mg/L
Short Term	*Lepomis macrochirus* [1]	96 LC_{50}	868
	Oncorhynchus mykiss [1]	96 LC_{50}	360
	Cyprinodon variegatus [1]	96 LC_{50}	2180
	Ictalurus punctatus [1]	96 LC_{50}	695
	Leuciscus idus melanotus [1]	NOEC	207 – 350
	Daphnia magna [1]	24 – 48 EC_{50}	165 – 500
	Palaemonetes pugio [1]	96 EC_{50}	1770
	Crassostrea virginica [1]	96 EC_{50}	89
	Selenastrum capricornutum [2]	96 EC_{50}	3
	Selenastrum capricornutum [1]	96 NOEC	1.3
	Algae [2]	96 NOEC	0.74
	Chlorella vulgaris [1]	48 NOEC	≥ 100
	Pseudomonas putida [1]	30-minute NOEC	1000
Long Term	*Oncorhynchus mykiss* [1]	14-day NOEC	60 – 180
	Daphnia magna [1]	28-day NOEC	10 – < 12.5
	Algae [2]	14-day NOEC	13

[1] Data cited in Jaworska et al.
[2] Data cited in HERA Phosphonates, 2004

Jaworska et al. and HERA, 2004 found acute toxicity endpoints for HEDP ranged from 0.74 to 2180 mg/L, while chronic toxicity NOECs were 60 – 180 mg/L for the 14-day NOEC for *Oncorhynchus mykiss*, and 10 – <12.5 mg/L for the 28-day NOEC for *Daphnia magna*. The highest short-term EC_{50} values reported by Jaworska et al. and HERA, 2004 for algae, *Selenastrum capricornutum* (3 ppm), *Daphnia magna* (165 – 500 ppm), and *Crassostrea virginica* (89 ppm), are considered to result from chelation effect, rather than intrinsic toxicity. Therefore, these values are not relevant in food processing wastewaters, where excess nutrients are present. The lowest relevant endpoint for food processing uses was determined by Jaworska et al. to be chronic NOEC of 10ppm for *Daphnia magna*. [13] In comparison, the HEDP maximum (worst-case) EEC value of 2.66 ppm in water for the proposed use of the FCS in poultry is well below the endpoint of 10 ppm chronic NOEC for *Daphnia magna*.

DPA: Due to lack of publicly available information regarding the ecological toxicity of DPA, an alternative approach is to use the US EPA's computerized predictive model referred to as the Ecological Structure Activity Relationships (ECOSAR) Class Program. [14] The ECOSAR program provides estimates of a chemical's acute and chronic toxicity to aquatic organisms by using computerized Structure Activity Relationships (SARs). Using the ECOSAR program, the following toxicity data of DPA (proxy: Pyridine-alpha-acid, and Neutral Organic SAR) were obtained for various aquatic organisms:

Environmental Toxicity Data for DPA:

Exposure Duration	ECOSAR Class	Species	Endpoint	mg/L
Short Term	Pyridine-alpha-acid	*Fish*	96 LC_{50}	324
	Neutral Organic SAR	*Fish*	96 LC_{50}	2657
	Neutral Organic SAR	*Daphnid*	48 LC_{50}	1322
	Neutral Organic SAR	*Green Algae*	96 EC_{50}	570
Long Term	Pyridine-alpha-acid	*Fish*	Chronic Value (ChV)	29
	Neutral Organic SAR	*Fish*	ChV	222
	Neutral Organic SAR	*Daphnid*	ChV	89
	Neutral Organic SAR	*Green Algae*	ChV	111

The complete ECOSAR report for this analysis is attached to this EA.

The values obtained above are all much higher than the highest EEC value for DPA, which is 0.65 ppm. This value is over 40 times lower than the lowest chronic toxicity endpoint for the most sensitive species (29 mg/L for fish). Therefore, the aquatic risks of the intended uses of DPA are expected to be negligible.

9. Use of Resources and Energy

The notified use of the FCS will not require additional energy resources for the treatment and disposal of waste solution because the components readily degrade. The FCS is expected to compete with, and to some degree replace similar HEDP and DPA stabilized peroxy antimicrobial agents already on the market. Thus, the FCS will consume comparable amounts of energy and resources as similar products. The raw materials that are used to manufacture the FCS are commercially manufactured chemicals that are produced for use in a variety of chemical reactions and production processes. Therefore, the energy used to produce the FCS is not significant.

10. Mitigation Measures

As discussed above, no significant adverse environmental impacts are expected to result from the use and disposal of the dilute FCS mixture. Thus, the use of the FCS as proposed does not require mitigating measures.

11. Alternatives to the Proposed Action

No adverse environmental impacts are identified herein that would necessitate alternative actions to that proposed in this Notification. The alternative of not approving the action proposed herein would result in continued use of currently marketed antimicrobial agents that the subject FCS would replace. Such action would have no significant environmental impact. The addition of the FCS to the options available to food processors is not expected to increase the use of peroxyacetic acid antimicrobial products.

12. List of Preparers

Beatrice Maingi, Senior Manager, QA, Compliance & Regulatory, Safe Foods Corporation/ LPR Technologies, 1501 E. 8th Street, North Little Rock, AR 72114. M.A and B.S. in Chemistry and MBA, 11 years of experience preparing regulatory submissions to international regulatory jurisdictions, 6 years preparing regulatory submissions to FSIS, and 4 years preparing regulatory submissions to FDA.

13. Certification

The undersigned official certifies that the information presented is true, accurate, and complete to the best of the knowledge of Safe Foods Corporation/ LPR Technologies.

Date: December 29, 2022

Beatrice Maingi
Senior Manager, QA, Compliance & Regulatory
Safe Foods Corporation/ LPR Technologies

14. References

1. European Center for Ecotoxicology and Toxicology of Chemicals, JACC No. 40: Peracetic Acid and Its Equilibrium Solutions, January 2001.

2. European Center for Ecotoxicology and Toxicology of Chemicals, JACC No. 22: Hydrogen Peroxide, January 1993.

3. U.S. High Production Volume (HPV) Chemical Challenge Program: Assessment Plan for Acetic Acid and Salts Category. Acetic Acid and Salts Panel, American Chemical Council, June 28, 2001.

4. The Organization for Economic Co-operation and Development (OECD) SIDS Voluntary Testing Program for International High Production Volume Chemicals, Sulfuric Acid, 2001, available online at http://www.inchem.org/documents/sids/sids/7664939.pdf

5. HERA-Human and Environmental Risk Assessment on Ingredients of European Household Cleaning Products: Phosphonates, www.heraproject.com-Phosphonates

6. Rapaport, Robert A., 1988. Prediction of consumer product chemical concentrations as a function of publicly owned treatment works treatment type and riverine dilution. Environmental Toxicology and Chemistry 7(2), 107-115. Found online at: http://onlinelibrary.wiley.com/doi/10.1002/etc.5620070204/full

7. Kaiser, J.P.; Feng, Y; Bollag, J.M. 1996. Microbial metabolism of pyridine, quinoline, acridine, and their derivatives under aerobic and anaerobic conditions. Microbiological Reviews 60(3), 483-498.

8. Amador, J.A.; Taylor, B.F. 1990. Coupled metabolic and photolytic pathway for degradation of pyridinecarboxylic acids, especially dipicolinic acid. Applied and Environmental Microbiology 56(5), 1352-1356.

9. Seyfried, B; Schink, B. 1990. Fermentative degradation of dipicolinic acid (pyridine-2,6-dicarboxylic acid) by a defined coculture of strictly anaerobic bacteria. Biodegradation 1, 1-7.

10. Naik, M.N.; Jackson, R.B.; Stokes, J.; Swaby, R.J. 1972. Microbial degradation and phytotoxicity of picloram and other substituted pyridines. Soil Biology and Biochemistry, 4, 313-323.

11. Arima, K; Kobayashi, Y. 1962. Bacterial oxidation of dipicolinic acid I.: Isolation of microorganisms, their culture conditions, and end products. J. Bacteriol. 84: 759-764.

12. Jaworska, J.; Van-Genderen-Takken, H.; Hanstveit, A.; van de Plasche, E.; Feijtel, T. 2002. Environmental risk assessment of phosphonates used in domestic laundry and cleaning agents in the Netherlands. Chemosphere 47, 655-665.

13. Ibid.

14. United States Environmental Protection Agency Ecological Structure Activity Relationships (ECOSAR) Predictive Model, available online at https://www.epa.gov/tsca-screening-tools/ecological-structure-activity-relationships-ecosar-predictive-model

15. Attachment: ECOTOX Report for Dipicolinic Acid

ECOSAR Version 1.11 Results Page

SMILES : OC(=O)c1cccc(n1)C(=O)(O)

CHEM : dipicolinic acid

CAS Num: 499-83-2

ChemID1:

MOL FOR: C7 H5 N1 O4

MOL WT : 167.12

Log Kow: 0.567 (EPISuite Kowwin v1.68 Estimate)

Log Kow: (User Entered)

Log Kow: (PhysProp DB exp value - for comparison only)

Melt Pt: (User Entered for Wat Sol estimate)

Melt Pt: 249.00 (deg C, PhysProp DB exp value for Wat Sol est, 249 dec)

Wat Sol: 4829 (mg/L, EPISuite WSKowwin v1.43 Estimate)

Wat Sol: (User Entered)

Wat Sol: 5000 (mg/L, PhysProp DB exp value)

Values used to Generate ECOSAR Profile

Log Kow: 0.567 (EPISuite Kowwin v1.68 Estimate)

Wat Sol: 5000 (mg/L, PhysProp DB exp value)

ECOSAR v1.11 Class-specific Estimations

Pyridine-alpha-Acid

ECOSAR Class	Organism	Duration	End Pt	Predicted mg/L (ppm)
==========================	=================	========	======	==========
Pyridine-alpha-Acid	: Fish	96-hr	LC50	323.608
Pyridine-alpha-Acid	: Fish		ChV	29.342 !
==========================	=================	========	======	==========
Neutral Organic SAR	: Fish	96-hr	LC50	2656.694
(Baseline Toxicity)	: Daphnid	48-hr	LC50	1321.570
	: Green Algae	96-hr	EC50	569.703
	: Fish		ChV	222.165
	: Daphnid		ChV	89.187
	: Green Algae		ChV	111.124

Note: * = asterisk designates: Chemical may not be soluble enough to measure this predicted effect. If the effect level exceeds the water solubility by 10X, typically no effects at saturation (NES) are reported.

NOTE: ! = exclamation designates: The toxicity value was estimated through application of acute-to-chronic ratios per methods outlined in the ECOSAR Methodology Document provided in the ECOSAR Help Menu.

Class Specific LogKow Cut-Offs

If the log Kow of the chemical is greater than the endpoint specific cut-offs presented below, then no effects at saturation are expected for those endpoints.

Pyridine-alpha-Acid :

Maximum LogKow: 5.0 (LC50)

Maximum LogKow: 6.4 (EC50)

Maximum LogKow: 8.0 (ChV)

Baseline Toxicity SAR Limitations:

Maximum LogKow: 5.0 (Fish 96-hr LC50; Daphnid LC50)

Maximum LogKow: 6.4 (Green Algae EC50)

Maximum LogKow: 8.0 (ChV)