Distillates, Petroleum, Hydrotreated Light (CAS# 64742-47-8) GreenScreen® for Safer Chemicals (GreenScreen®) Assessment

Prepared for:

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GreenScreen® Executive Summary for Distillates, Petroleum, Hydrotreated Light (CAS #64742-47-8)

Distillates, petroleum, hydrotreated light is a chemical that is used as a chemical intermediate, fuel, lubricant, coating, cleaning agent, metal working fluid, release agent, and a friction reducer in hydraulic fracturing fluids.

Distillates, petroleum, hydrotreated light was assigned a GreenScreen® Benchmark Score of 2 ("Use but search for safer substitutes") as it has Moderate persistence (P), Very High bioaccumulation (B), Moderate Group I Toxicity (carcinogenicity (C) and mutagenicity (M)), Moderate Group II Toxicity (skin irritation (IrS) and systemic toxicity -repeated dose (STr*)), and High ecotoxicity (acute aquatic (AA) and chronic aquatic (CA) . This corresponds to GreenScreen® benchmark classification 2a, 2d, and 2e in CPA 2011. Data gaps (DG) exist for endocrine activity (E) and respiratory sensitization (SnR*). As outlined in CPA (2013) Section 12.2 (Step 8 – Conduct a Data Gap Analysis to assign a final Benchmark score), distillates, petroleum, hydrotreated light meets requirements for a GreenScreen® Benchmark Score of 2 despite the hazard data gaps. In a worst-case scenario, if distillates, petroleum, hydrotreated light were assigned a High score for the data gaps endocrine activity (E) or respiratory sensitization (SnR*), or Very High for systemic toxicity-single dose (STs) or neurotoxicity-single dose (Ns), it would be categorized as a Benchmark 1 Chemical.

GreenScreen® Benchmark Score for Relevant Route of Exposure:

As a standard approach for GreenScreen® evaluations, all exposure routes (oral, dermal and inhalation) were evaluated together, so the GreenScreen® Benchmark Score of 2 ("Use but search for safer substitutes") is applicable for all routes of exposure.

GreenScreen® Hazard Ratings for Distillates, Petroleum, Hydrotreated Light

Group I Human					Group II and II* Human									Ecotox		Fate		Physical	
C	M	R	D	E	AT	ST		N		SnS*	SnR*	IrS	IrE	AA	CA	P	B	Rx	F
						single	repeated*	single	repeated*										
M	*M*	**L**	**L**	DG	**L**	DG	**M**	DG	**L**	**L**	DG	**M**	**L**	**H**	**H**	**M**	*vH*	**L**	**M**

Note: Hazard levels (Very High (vH), High (H), Moderate (M), Low (L), Very Low (vL)) in *italics* reflect estimated (modeled) values, authoritative B lists, screening lists, weak analogues, and lower confidence. Hazard levels in **BOLD** font are used with good quality data, authoritative A lists, or strong analogues. Group II Human Health endpoints differ from Group II* Human Health endpoints in that they have four hazard scores (i.e., vH, H, M, and L) instead of three (i.e., H, M, and L), and are based on single exposures instead of repeated exposures. Please see Appendix A for a glossary of hazard acronyms.

GreenScreen® Assessment for Distillates, Petroleum, Hydrotreated Light (CAS #64742-47-8)

Method Version: GreenScreen® Version 1.2[1]
Assessment Type[2]: Certified

Chemical Name: Distillates, petroleum, hydrotreated light

CAS Number: 64742-47-8

GreenScreen® Assessment Prepared By:
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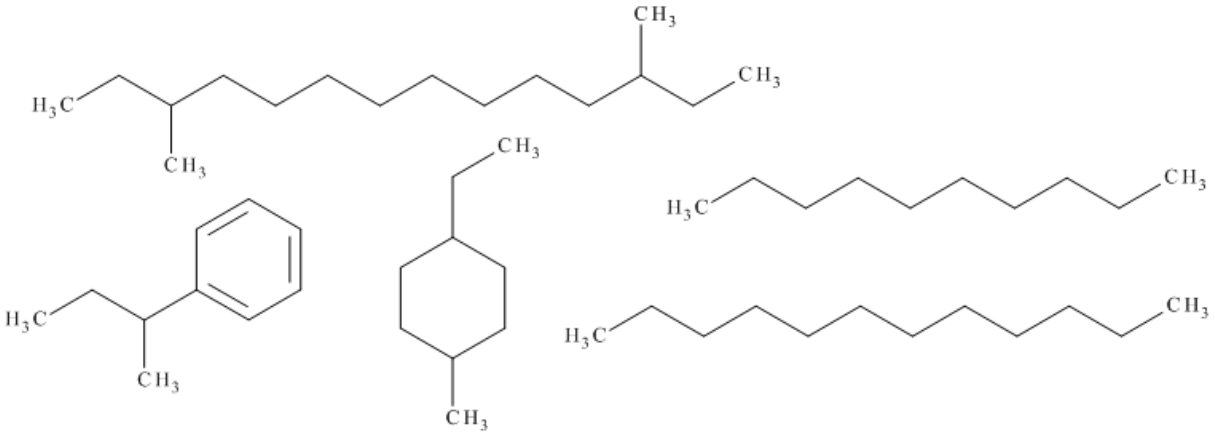
Organization: ToxServices LLC
Date: June 25, 2014

Confirm application of the *de minimus* rule[3]: N/A

Chemical Structure(s):



Distillates, petroleum, hydrotreated light (CAS #64742-47-8) representative hydrocarbon structures (U.S. EPA 2011)

Also called: Hydrotreated kerosene; Hydrotreated light distillates (petroleum); Turbo fuel A; Distillates (petroleum), hydrotreated light; Distillate fuel oils, light; Hydrotreated light distillate

Chemical Structure(s) of Chemical Surrogates Used in the GreenScreen®:
Few data were available for distillates, petroleum, hydrotreated light (CAS #64742-47-8). Distillates, petroleum, hydrotreated light is a member of U.S. EPA's Kerosene/Jet Fuels category

[1] Use GreenScreen® Assessment Procedure (Guidance) V1.2
[2] GreenScreen® reports are either "UNACCREDITED" (by unaccredited person), "AUTHORIZED" (by Authorized GreenScreen® Practitioner), "CERTIFIED" (by Licensed GreenScreen® Profiler or equivalent) or "CERTIFIED WITH VERIFICATION" (Certified or Authorized assessment that has passed GreenScreen® Verification Program)
[3] Every chemical in a material or formulation should be assessed if it is:
1. intentionally added and/or
2. present at greater than or equal to 100 ppm

(U.S. EPA 2011). Members of this category are complex petroleum refinery streams derived from crude oil. They are similar complex mixtures of hydrocarbons with carbon length ranging from C9-C16, and share similar physicochemical properties, including moderate-high vapor pressure and low-moderate water solubility. Therefore, members of this category are expected to have similar environmental fate and toxicity profiles. As supporting chemicals, U.S. EPA's assessment of this category included data on jet fuels, which are primarily composed of kerosene. Since few data were available for distillates, petroleum, hydrotreated light, data for the following members of and supporting chemicals for U.S. EPA's Kerosene/Jet Fuels category were also evaluated:

- Hydrodesulfurized kerosene (CAS# 34742-81-0)
- Kerosene, petroleum (CAS# 64742-81-0)
- Jet Fuel A (No CAS#)
- Jet Fuel JP-8 (No CAS#)
- Jet Fuel JP-5 (No CAS#)
- Sweetened Kerosene (Petroleum) (CAS# 91770-15-9)
- Diesel fuel (CAS# 68334-30-5)
- JP-4 (heavy kerosene) (CAS# 50815-00-4)
- Naphtha (petroleum), hydrotreated heavy (CAS# 64742-48-9)

Scores based on surrogates were considered to be of high confidence due to the similiarity in chemical composition and physicochemical properties for members of the class.

Identify Applications/Functional Uses: (ECHA 2014, Inglewood Oil Field 2012)
1. Chemical intermediate
2. Fuel
3. Lubricant
4. Coating
5. Cleaning agent
6. Metal working fluid
7. Release agent
8. Friction reducer in hydraulic fracturing fluids

GreenScreen® Summary Rating for Distillates, Petroleum, Hydrotreated Light[4]: Distillates, petroleum, hydrotreated light was assigned a GreenScreen® Benchmark Score of 2 ("Use but search for safer substitutes") as it has Moderate persistence (P), Very High bioaccumulation (B), Moderate Group I Toxicity (carcinogenicity (C) and mutagenicity (M)), Moderate Group II Toxicity (skin irritation (IrS) and systemic toxicity-repeated dose (STr*)), and High ecotoxicity (acute aquatic (AA) and chronic aquatic (CA) . This corresponds to GreenScreen® benchmark classification 2a, 2d, and 2e in CPA 2011. Data gaps (DG) exist for Endocrine Activity (E) and Respiratory Sensitization (SnR*). As outlined in CPA (2013) Section 12.2 (Step 8 – Conduct a Data Gap Analysis to assign a final Benchmark score), distillates, petroleum, hydrotreated light meets requirements for a GreenScreen® Benchmark Score of 2 despite the hazard data gaps. In a worst-case scenario, if distillates, petroleum, hydrotreated light were assigned a High score for the data gaps endocrine activity (E) or respiratory sensitization (SnR*), or Very High for systemic toxicity -single dose (STs) or neurotoxicity-single dose (Ns), it would be categorized as a Benchmark 1 Chemical.

[4] For inorganic chemicals with low human and ecotoxicity across all hazard endpoints and low bioaccumulation potential, persistence alone will not be deemed problematic. Inorganic chemicals that are only persistent will be evaluated under the criteria for Benchmark 4.

Figure 1: GreenScreen® Hazard Ratings for Distillates, Petroleum, Hydrotreated Light

Group I Human					Group II and II* Human									Ecotox		Fate		Physical	
C	M	R	D	E	AT	ST		N		SnS*	SnR*	IrS	IrE	AA	CA	P	B	Rx	F
						single	repeated*	single	repeated*										
M	*M*	L	L	DG	L	DG	M	DG	L	L	DG	M	L	H	H	M	*vH*	L	M

Note: Hazard levels (Very High (vH), High (H), Moderate (M), Low (L), Very Low (vL)) in *italics* reflect estimated (modeled) values, authoritative B lists, screening lists, weak analogues, and lower confidence. Hazard levels in **BOLD** font are used with good quality data, authoritative A lists, or strong analogues. Group II Human Health endpoints differ from Group II* Human Health endpoints in that they have four hazard scores (i.e., vH, H, M, and L) instead of three (i.e., H, M, and L), and are based on single exposures instead of repeated exposures. Please see Appendix A for a glossary of hazard acronyms.

Transformation Products and Ratings:

Identify feasible and relevant fate and transformation products (i.e., dissociation products, transformation products, valence states) **and/or moieties of concern**[5].

No feasible and relevant transformation products were identified. CO, CO_2, and H_2O may be produced by combustion but are naturally occurring and are not assessed. Hydrolysis is a negligible transformation process as the hydrocarbons do not contain hydrolysable functional groups (U.S. EPA 2011).

Introduction

Distillates, petroleum, hydrotreated light are a complex combination of hydrocarbons obtained from a petroleum stock by treating with hydrogen to convert organic sulfur to hydrogen sulfide, which is removed. Distillates, petroleum, hydrotreated light is a mixture of hydrocarbons with carbon numbers ranging from C9 to C16 and a boiling point ranging 150 to 290 °C. It is a member of U.S. EPA's category of Kerosene/Jet Fuels (U.S. EPA 2011). It is used as a chemical intermediate, fuel, lubricant, coating, cleaning agent, metal working fluid, release agent (ECHA 2014).

ToxServices assessed distillates, petroleum, hydrotreated light against GreenScreen® Version 1.2 (CPA 2013) following procedures outlined in ToxServices' SOP 1.37 (GreenScreen® Hazard Assessment) (ToxServices 2013).

GreenScreen® List Translator Screening Results

The GreenScreen® List Translator identifies specific authoritative or screening lists that should be searched to identify GreenScreen® benchmark 1 chemicals (CPA 2012b). Pharos (Pharos 2014) is an online list-searching tool that is used to screen chemicals against the List Translator electronically. The output indicates benchmark or possible benchmark scores for each human health and environmental endpoint. The output for distillates, petroleum, and hydrotreated light can be found in Appendix C and classifications for specific endpoints can be found in the appropriate sections. When a classification from GHS New Zealand was available for any endpoint, it was converted to the harmonized GHS classifications using the "Correlation between GHS and New Zealand HSNO Hazard Classes and Categories" document from the New Zealand Environmental Protection Authority (N.Z. EPA 2009)

[5] A moiety is a discrete chemical entity that is a constituent part or component of a substance. A moiety of concern is often the parent substance itself for organic compounds. For inorganic compounds, the moiety of concern is typically a dissociated component of the substance or a transformation product.

PhysicoChemical Properties of Distillates, petroleum, hydrotreated light

Distillates, petroleum, hydrotreated light are liquid at room temperature. It has low-moderate water solubility, and its vapor pressure of 0.05-5.4 mmHg indicates that it is volatile and will likely vaporize. Its Log K_{ow} of 3.7-8.0 indicates some potential for bioaccumulation.

Table 1: Physical and Chemical Properties of Distillates, Petroleum, Hydrotreated Light (CAS #64742-47-8)

Property	Value	Reference
Molecular formula	Unspecified (mixture)	
SMILES Notation	Unspecified (mixture)	
Molecular weight	Unspecified (mixture)	
Physical state	Liquid	U.S. EPA 2011
Appearance	Pale yellow/colorless liquid	Shell 2012
Melting point	< 0 °C (typical pour point)	U.S. EPA 2011
Vapor pressure	0.03-5.4 mmHg at 25°C	U.S. EPA 2011
Water solubility	0.001-52.2 mg/L at 25°C	U.S. EPA 2011
Dissociation constant	Not applicable	U.S. EPA 2011
Density/specific gravity	0.799-0.825 g/cm^3 at 15°C	ESIS 2000
Partition coefficient	Log K_{ow} = 3.7-8.0	U.S. EPA 2011

Hazard Classification Summary Section:

Group I Human Health Effects (Group I Human)

Carcinogenicity (C) Score (H, M, or L): M

Distillates, petroleum, hydrotreated light were assigned a score of Moderate for carcinogenicity based on animal studies and its presence on an authoritative list. GreenScreen® criteria classify chemicals as a Moderate hazard for carcinogenicity when animal data provide limited or marginal evidence of carcinogenicity, and the chemical is classified as MAK Carcinogen Group 3B - Evidence of carcinogenic effects but not sufficient for classification (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* German MAK - List of Substances (MAK): Carcinogen Group 3B - Evidence of carcinogenic effects but not sufficient for classification
  - *Screening:* Not present on any screening lists

Kerosene/Jet Fuel Category

- API 2010
  - Dermal carcinogenicity studies of kerosene have found that kerosene does not initiate skin tumors, but it is a skin tumor promoter. Prolonged dermal irritation is required for tumor promotion, and when kerosene is applied to the skin in a manner that does not cause irritation, no tumors occur. Hyperplasia is thought to be essential for tumor formation.

Distillates, petroleum, hydrotreated light (CAS# 64742-47-8)

- ECHA 2014
  - In a dermal carcinogenicity study in male C3H mice, animals (50/dose) were dermally administered 50 mg of distillates, petroleum, hydrotreated light (CAS# 64742-47-8) to the shaved skin of the back twice weekly for 102 weeks. Incidence of dermal papillomas was significantly increased compared to controls, with a mean latency of 79 weeks.

Kerosene, petroleum (CAS# 8008-20-6)

- U.S. EPA 2011
    - In a 2-year dermal carcinogenicity study in male CH3 mice, animals (50/dose) were dermally administered 50 µL of 28.5% kerosene 7 days/week, 50% kerosene 4 days/week, or 100% kerosene 2 days/week. No tumors were seen in the absence of skin irritation, but kerosene showed evidence of tumor promotion.
- ECHA 2014
    - In a 2-year dermal carcinogenicity study in male C3H mice, animals (50/dose) were dermally administered 50 µL kerosene to the intrascapular region twice weekly. Dermal tumor incidence increased, with a latency period of 77 weeks.

Jet Fuel JP-5 (No CAS#)

- U.S. EPA 2011
    - In a 2-year dermal carcinogenicity study in male and female B6C3F1 mice, animals (50/sex/dose) were dermally administered 0, 250, or 500 mg/kg/day JP-5. Chronic dermatitis increased with dose, but no carcinogenicity was observed.

Hydrodesulfurized kerosene (CAS# 64742-81-0)

- API 2010
    - Hydrodesulfurized kerosene was not a tumor initiator but showed tumor promoting activity in an initiation-promotion assay in male CD-1 mice. No additional details were provided.
- ECHA 2014
    - In a dermal carcinogenicity study in male and female C3H/HeJ mice, animals (50/sex/dose) were administered 50 µL API 81-07 to the intrascapular region twice weekly for a lifetime. Chronic skin irritation was observed, and an increase in dermal tumors with a long latency period of 76 weeks was seen.

Jet Fuel A (No CAS#)

- ECHA 2014
    - In a dermal carcinogenicity study in male C3H mice, animals (25/dose) were dermally administered 25 mg of Jet A to the shaved skin of the back three times weekly for 105 weeks. As significant increase in dermal tumors (squamous cell carcinomas of fibrosarcomas) was seen.
    - In a dermal carcinogenicity study in male C3H/HeNCrlBR mice, animals (50/dose) were dermally administered 37.5 µL Jet A to the shaved skin of the back twice weekly for 2 years, or intermittently so that application was suspended when dermal irritation was noted in 20% of animals and resumed when irritation resolved in all but 20% of affected animals. An increase in dermal tumor incidence was seen with continuous treatment but not when treatment was suspended due to irritation.
- Based on the weight of evidence, a score of moderate was assigned. distillates, petroleum, hydrotreated light is classified as MAK Carcinogen Group 3B - Evidence of carcinogenic effects but not sufficient for classification, which corresponds to a score of Moderate. Additionally, available data for distillates, petroleum, hydrotreated light, members of the Kerosene/Jet Fuel Category, and supporting chemicals demonstrate that these chemicals may promote skin tumors though prolonged skin irritation. Therefore, a score of Moderate is appropriate.

Mutagenicity/Genotoxicity (M) Score (H, M, or L): *M*

Distillates, petroleum, hydrotreated light was assigned a score of Moderate for mutagenicity/genotoxicity based on positive *in vivo* clastogenicity and *in vivo* mammalian mutagenicity assays for members of the Kerosene/Jet Fuel Category and supporting chemicals.

GreenScreen® criteria classify chemicals as a Moderate hazard for mutagenicity/genotoxicity when there is limited or moderate evidence of genotoxicity (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists

Distillates, petroleum, hydrotreated light (CAS# 64742-47-8)

- ESIS 2000
    - Distillates, petroleum, hydrotreated light was negative in a GLP compliant bacterial reverse mutation assay in *S. typhimurium* strains TA98, TA100, TA1535, TA1537, and TA1538 at concentrations of 0.001 – 5.0 µL/plate.
    - ExxsolD40 (containing distillates, petroleum, hydrotreated light (CAS# 64742-47-8) and Naphtha (petroleum), hydrotreated heavy (CAS# 64742-48-9)) was negative in a dominant lethal inhalation assay (species not specified) at doses of 0, 300 or 900 ppm. No additional details were provided.
    - Exxsol D60 (containing distillates, petroleum, hydrotreated light (CAS# 64742-47-8) and Naphtha (petroleum), hydrotreated heavy (CAS# 64742-48-9)) and Isoapar M (containing distillates, petroleum, hydrotreated light (CAS# 64742-47-8)) were negative in *in vivo* mouse bone marrow cytogenetics assays at doses of 1.25, 2.5 or 5.0 g/kg. No additional details were provided.
    - Exxsol D60 (containing distillates, petroleum, hydrotreated light (CAS# 64742-47-8) and Naphtha (petroleum), hydrotreated heavy (CAS# 64742-48-9)) was negative in an Ames mutagenicity assay at doses of 100, 320, 1,000, 3,200, and 10,000 µg/plate with and without metabolic activation. No additional details were provided.
    - Exxsol D100S (containing distillates, petroleum, hydrotreated light (CAS# 64742-47-8)) was negative in an Ames mutagenicity assay at concentrations of 50, 150, 1,500, or 5,000 µg/plate with and without metabolic activation. No additional details were provided.
    - Exxsol D100S (containing distillates, petroleum, hydrotreated light (CAS# 64742-47-8)) was negative in an *in vitro* mammalian chromosome aberration test at concentrations of 3.13 – 750 µg/L with and without metabolic activation. No additional details were provided.
    - Isopar M (containing distillates, petroleum, hydrotreated light (CAS# 64742-47-8)) was negative in an Ames mutagenicity assay at concentrations of 100, 320, 1,000, 3,200, and 10,000 µg/plate. No additional details were provided.
    - Isopar M (containing distillates, petroleum, hydrotreated light (CAS# 64742-47-8)) was negative in an *in vitro* cytogenetic assay. No additional details were provided.

Kerosene, petroleum (CAS# 8008-20-6)

- U.S. EPA 2011
    - Kerosene, straight run API sample 83-09 was positive in an *in vitro* mammalian cell gene mutagenicity assay in mouse lymphoma L5178Y cells at concentrations of 0.0067-0.5 µL/mL with and without metabolic activation. No additional details were provided.
    - Kerosene, straight run was negative in an *in vitro* mammalian cell gene mutagenicity assay in mouse lymphoma L5178Y cells at concentrations of 0.004-0.064 µL/mL with metabolic activation and 0.006-0.13 µL/mL without metabolic activation.

Hydrodesulfurized kerosene (CAS# 64742-81-0)

- U.S. EPA 2011
    - Hydrodesulfurized kerosene sample API 81-07 was negative for mutagenicity in an *in vitro* mammalian cell gene mutagenicity assay in mouse lymphoma L5178Y cells at concentrations of 0, 6.25, 12.5, 25, and 37.5 nL/mL with and without metabolic

activation.
    - Hydrodesulfurized kerosene sample API 81-07 was negative in an *in vitro* sister chromatid exchange (SCE) assay in Chinese hamster ovary (CHO) cells at concentrations of 0, 0.007, 0.013, 0.025, and 0.05 mg/L with and without metabolic activation. Significant increases in SCE's in some dose groups were not considered treatment-related since the response was not dose-related.
    - Hydrodesulfurized kerosene was positive in an *in vivo* chromosome aberration assay in male and female B6C3F1 mice (5/sex/dose) that were administered 0, 400, 2,000, or 4,000 mg/kg via i.p. injection. Increases in chromosome aberrations were seen in all three treatment groups.
    - Hydrodesulfurized kerosene sample API 81-07 was negative in an *in vivo* chromosome aberration assay in male and female Sprague-Dawley rats (15/sex/dose) that were administered 0, 0.3, 1, or 3 g/kg via i.p. injection and were examined 6, 24, and 48 hours later.

Jet Fuel A (No CAS#)

- U.S. EPA 2011
    - Jet Fuel A was positive in an *in vitro* mammalian cell gene mutagenicity assay in mouse lymphoma L5178Y cells at concentrations of 100-1,200 µg/mL with metabolic activation. Results were negative without metabolic activation.
    - Jet Fuel A was positive in an *in vivo* chromosome aberration assay in 5 male Sprague-Dawley rats administered 0 or 100 ppm Jet Fuel A vapor for 6 hours/day for 20 days or 400 ppm for 6 hour/day for 5 days. Chromosome aberrations were significantly increased in all treatment groups.
- API 2010
    - Jet Fuel A was negative in a standard Ames assay with and without metabolic activation. No additional details were provided.
    - Jet Fuel A and five middle distillates were negative in Ames assays in *S. typhimurium* strain TA98. No additional details were provided.
    - Jet Fuel A was negative in a dominant lethal assay in mice administered 100 or 400 ppm for 6 hours/day for 8 weeks via inhalation. No additional details were provided.
    - Jet Fuel A was negative in an *in vivo* micronucleus assay in CD-1 mice. No increase in micronuclei was seen in bone marrow at 24, 48, or 72 hours after treatment. No additional details were provided.
    - Jet Fuel A was negative in a micronucleus assay in mice treated dermally with a single or multiple applications. No increase in micronuclei was seen in bone marrow or peripheral blood. No additional details were provided.

Jet Fuel JP-8 (No CAS#)

- API 2010
    - JP-8 was negative in an Ames assay in *S. typhimurium*. No additional details were provided.
    - JP-8 was negative in an *in vitro* mutagenicity assay in mouse lymphoma L5178Y cells. No additional details were provided.
    - JP-8 was positive for DNA damage in a Comet assay in H411E rat hepatoma cells at concentrations from 0-20 µg/mL for 4 hours. A dose dependent increase in mean comet tail moments indicative of DNA damage was observed. No additional details were provided.

  - JP-8 was negative in dominant lethal assays in mice administered 0.13, 0.4, or 1.3 mL/kg and rats administered 0.1, 0.3, or 1.0 mL/kg orally for 5 days. No additional details were provided.
  - JP-8 was negative in a micronucleus assay in mice treated dermally with a single or multiple applications. No increase in micronuclei was seen in bone marrow or peripheral blood. No additional details were provided.

Jet Fuel JP-5 (No CAS#)

- API 2010
  - JP-5 was negative in an Ames assay in *S. typhimurium* strains TA97, TA98, TA100, TA1535, and TA1537 at concentrations of 100-10,000 µg/plate. No additional details were provided.

Sweetened Kerosene (Petroleum) (CAS# 91770-15-9)

- API 2010
  - Sweetened kerosene was negative in a dominant lethal assay in rats administered 1 g/kg via i.p. injection and mice administered 1 g/kg via subcutaneous injection. No additional details were provided.
  - Sweetened kerosene was negative in an *in vivo* chromosome aberration assay in Sprague-Dawley rats administered a single i.p. injection of up to 3 g/kg. No additional details were provided.

Kerosene (not specified)

- API 2010
  - Kerosene (not specified) was negative in standard and optimized Ames assays with and without metabolic activation, with the exception of one positive assay with metabolic activation. No additional details were provided.
- Based on the weight of evidence, a score of moderate was assigned due to inconsistent positive results in *in vivo* chromosome aberration assays, *in vitro* mammalian cell mutagenicity assays, and a Comet assay for members of the Kerosene/Jet Fuel Category and supporting chemicals. Although several genotoxicity studies were negative, GreenScreen® criteria classify a chemical as a moderate when there is limited or marginal evidence of genotoxicity. Confidence in this score is reduced due to equivocal data.

Reproductive Toxicity (R) Score (H, M, or L): L

Distillates, petroleum, hydrotreated light was assigned a score of Low for reproductive toxicity based on a reproductive toxicity screening test for a member of the Kerosene/Jet Fuel Category. GreenScreen® criteria classify chemicals as a Low hazard for reproductive toxicity when adequate data are available and are negative for reproductive effects, and the chemical is not present on screening or authoritative lists (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists

Hydrodesulfurized kerosene (CAS# 64742-81-0)

- U.S. EPA 2011, API 2010
  - Hydrodesulfurized kerosene was tested in a dermal reproductive and developmental toxicity screening test (OECD Guideline 421) in Sprague-Dawley rats. Animals (10/sex/dose) were administered 0, 165, 330, or 494 mg/kg/day on unoccluded skin from 14 days prior to mating through gestation day 20 (females) or postnatal day 4 (males). The death of one female was unrelated to treatment. Decreased weight gain and increased relative kidney weight were seen in males at the high dose. No effects on testes or

epididymis in males or ovaries in females were seen. No treatment related effects on reproductive or developmental parameters were seen. U.S. EPA and API identified a NOAEL of 494 mg/kg/day for reproductive toxicity.

Jet Fuel JP-5 (No CAS#)

- API 2010
  - No histological changes in the reproductive system were seen in B6C3F1 mice dermally exposed to 2-8 g/kg/day JP-5 for 13 weeks.
- Based on the weight of evidence, a score of Low was assigned. No treatment related effects on reproduction were seen in a dermal reproductive toxicity screening test in rats. Although GLP status was not specified, the study was well conducted according to OECD Guideline 421. A 90-day dermal toxicity study in mice reported no histological effects on the reproductive system. Although reproductive function was not measured in this study, the lack of effects on reproductive organs lends support to the score of Low.

Developmental Toxicity incl. Developmental Neurotoxicity (D) Score (H, M, or L): L

Distillates, petroleum, hydrotreated light was assigned a score of Low for developmental toxicity based on oral, dermal, and inhalation developmental toxicity studies for distillates, petroleum, hydrotreated light, members of the Kerosene/Jet Fuel Category, and supporting chemicals. GreenScreen® criteria classify chemicals as a Low hazard for developmental toxicity when adequate data are available and are negative for developmental toxicity, and the chemical is not present on screening or authoritative lists (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* German MAK - List of Substances (MAK): Pregnancy Risk Group C
  - *Screening:* Not present on any screening lists

Distillates, petroleum, hydrotreated light (CAS# 64742-47-8)

- U.S. EPA 2006
  - In an inhalation developmental toxicity study of Exxsol D40 (containing distillates, petroleum, hydrotreated light (CAS# 64742-47-8) and naphtha (petroleum), hydrotreated heavy (CAS# 64742-48-9)) in Sprague-Dawley rats, dams (20-2/dose) were exposed to 300 or 900 ppm via inhalation (whole body) for 6 hours/day on gestation days 6-15. Dams were sacrificed on gestation day 21. No maternal toxicity or malformations (external, visceral, or skeletal) were seen, and U.S. EPA identified a NOAEL of 900 ppm (5.3 mg/L[6]) for developmental effects.

Hydrodesulfurized kerosene (CAS# 64742-81-0)

- U.S. EPA 2011, API 2010
  - In the dermal reproductive and developmental toxicity screening test (OECD Guideline 421) in Sprague-Dawley rats described above for reproductive toxicity, animals (10/sex/dose) were administered 0, 165, 330, or 494 mg/kg/day on unoccluded skin from 14 days prior to mating through gestation day 20 (females) or postnatal day 4 (males). Pup survival was decreased in the high dose, but was considered to be due to a water bottle malfunction rather than the test substance, and exclusion of this litter resulted in no significant effects on survival. U.S. EPA identified a NOAEL of 494 mg/kg/day for developmental toxicity. Source

Kerosene, petroleum (CAS# 8008-20-6)

- U.S. EPA 2011
  - In an inhalation developmental toxicity study in Sprague-Dawley rats, dams (20/dose)

[6] mg/L = (ppm)(MW)/(24,450) = (900)(143)/(24,450) = 5.3 mg/L using average molecular weight for Exxsol D40 (U.S. EPA 2006)

were administered 0, 106 or 364 ppm (analytical concentrations) kerosene vapor for 6 hours/day on gestation days 6-15. No effects implantations, resorptions, litter size, fetal weight, fetal death, sex ratio, skeletal or visceral anomalies were seen. U.S. EPA identified a NOAEL of 364 ppm (mg/L[7]) for developmental toxicity.

Jet Fuel A (No CAS#)

- U.S. EPA 2011
    - In an inhalation developmental toxicity study in Sprague-Dawley rats, dams (5/dose) were administered 102.5 or 394.7 ppm (analytical concentrations) vapor via whole body inhalation on gestation days 6-15. No effects on mean live litter size, skeletal malformations, pup sex ratio, dead fetuses, implantation sites, resorptions, nidation index or average fetal weight were seen. U.S. EPA identified a NOAEL of 394.7 ppm (2.7 mg/L[8]) for developmental toxicity based on the lack of effects.

Jet Fuel JP-8 (No CAS#)

- U.S. EPA 2011
    - In an oral developmental toxicity study in rats (strain not specified), dams were administered 0, 500, 1,000, 1,500, or 2,000 mg/kg/day JP-8 via gavage on gestation days 6-15. Maternal body weight gain was significantly decreased in all treatment groups (31, 70, and 85%). Adjusted body weight was decreased in the two highest dose groups. Fetal body weight for both sexes was decreased at the 1,500 mg/kg/day dose. Fetal alterations (not specified) increased in the 500 and 1,500 mg/kg/day dose groups but not in the high dose group. The number and types of malformations did not differ between groups. U.S. EPA identified a NOAEL of 1,000 mg/kg/day and LOAEL of 1,500 mg/kg/day for developmental toxicity based on decreased fetal body weight.
- Based on the weight of evidence, a score of low was assigned. Distillates, petroleum, hydrotreated light are classified as MAK Pregnancy Risk Group C, which corresponds to a score of low to moderate. One study of Jet Fuel JP-8 found effects on fetal body weight, but effects were only seen at a high dose (1,500 mg/kg/day) and no dose response was seen. All other studies for members of the Kerosene/Jet Fuel Category and supporting chemicals were negative for developmental effects.

Endocrine Activity (E) Score (H, M, or L): DG

Distillates, petroleum, hydrotreated light was assigned a score of data gap for endocrine disruption based on a lack of data for this endpoint.

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists
- Not listed as a potential endocrine disruptor on the EU Priority List of Suspected Endocrine Disruptors.
- Not listed as a potential endocrine disruptor on the OSPAR List of Chemicals of Possible Concern.
- No data were identified.

[7] mg/L = (ppm)(MW)/(24,450) = (364)(170)/(24,450) = 2.5 mg/L using average molecular weight for kerosene (Varmentguard 2004)

[8] mg/L = (ppm)(MW)/(24,450) = (394.7)(170)/(24,450) = 2.7 mg/L using average molecular weight for kerosene (Varmentguard 2004) (no molecular weight data for Jet Fuel A were identified)

Group II and II* Human Health Effects (Group II and II* Human)

Note: Group II and Group II* endpoints are distinguished in the v 1.2 Benchmark system. For Systemic Toxicity and Neurotoxicity, Group II and II* are considered sub-endpoints and test data for single or repeated exposures may be used. If data exist for single OR repeated exposures, then the endpoint is not considered a data gap. If data are available for both single and repeated exposures, then the more conservative value is used.

Acute Mammalian Toxicity (AT) Group II Score (vH, H, M, or L): L

Distillates, petroleum, hydrotreated light was assigned a score of Low for acute toxicity based on experimental oral, dermal, and inhalation LD_{50} values for distillates, petroleum, hydrotreated light and members of the Kerosene/Jet Fuel Category. GreenScreen® criteria classify chemicals as a Low hazard for acute toxicity when oral and dermal LD_{50} values are greater than 2,000 mg/kg (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists

Distillates, petroleum, hydrotreated light (CAS# 64742-47-8)

- ESIS 2000
  - *Oral*: LD_{50} (rat, sex and strain not specified) > 15,000 mg/kg)
- U.S. EPA 2006
  - *Oral*: LD_{50} (rat, sex and strain not specified) > 10 g/kg
  - *Inhalation*: LD_{50} (rat, sex and strain not specified) > 5.3 mg/L
  - *Inhalation*: LD_{50} (rat, sex and strain not specified) > 7 mg/L
  - *Inhalation*: LD_{50} (rat, sex and strain not specified) > 6 mg/L

Kerosene, petroleum (CAS# 8008-20-6)

- U.S. EPA 2011
  - *Oral*: LD_{50} (rat, Sprague-Dawley, male and female) > 5,000 mg/kg (API 83-09)
  - *Dermal*: LD_{50} (rabbit, New Zealand, male and female) > 2,000 mg/kg
  - *Inhalation*: LD_{50} (rat, Sprague-Dawley, male and female) > 5.2 mg/L (4-h)
  - *Inhalation*: LC_{50} (species, sex, and strain not specified) > saturated vapors

Hydrodesulfurized kerosene (CAS# 64742-81-0)

- U.S. EPA 2011
  - *Oral*: LD_{50} (species, sex, and strain not specified) > 5,000 mg/kg (API 81-07)
  - *Dermal*: LD_{50} (species, sex, and strain not specified) > 2,000 mg/kg
  - *Inhalation*: LC_{50} (species, sex, and strain not specified) > 5.2 mg/L (4-h)

Jet Fuel A (No CAS#)

- U.S. EPA 2011
  - *Oral*: LD_{50} (species, sex, and strain not specified) > 20,000 mg/kg
  - *Dermal*: LD_{50} (species, sex, and strain not specified) > 4,000 mg/kg

Systemic Toxicity/Organ Effects incl. Immunotoxicity (ST)

Group II Score (single dose) **(vH, H, M, or L):** DG

Distillates, petroleum, hydrotreated light were assigned a score of data gap for systemic toxicity (single dose) based on a lack of data for this endpoint.

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- No data were identified.

Group II* Score (repeated dose) **(H, M, or L): M**

Distillates, petroleum, hydrotreated light was assigned a score of Moderate for systemic toxicity (repeated dose) based on subchronic toxicity studies of distillates, petroleum, hydrotreated light, members of the Kerosene/Jet Fuel Category, and supporting chemicals that identified the lowest inhalation LOAECs of 0.5 to 0.75 mg/L in rats and mice. GreenScreen® criteria classify chemicals as a Moderate hazard for systemic toxicity (repeated dose) when inhalation LOAECs are between 0.2 and 1 mg/L in subchronic studies (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists

<u>Distillates, petroleum, hydrotreated light (CAS# 64742-47-8)</u>

- U.S. EPA 2006
  - *Oral*: In a 90-day oral toxicity study of Exxsol D60 (containing distillates, petroleum, hydrotreated light (CAS# 64742-47-8) and naphtha (petroleum), hydrotreated heavy (CAS# 64742-48-9)) in male and female Sprague-Dawley rats, animals (10/sex/dose) were administered 0, 500, 2,500, or 5,000 mg/kg/day via gavage. An additional 10 rats/sex were administered the high dose for 90 days followed by the control diet for a 4-week recovery period. No treatment-related mortality was observed. At the high dose, swollen anus, anogenital staining, and alopecia were seen. Body weight was significantly decreased in mid and high dose males and females. A high incidence (>70%) of stomach abnormalities was seen in both sexes at the two highest doses. Hyperplasia and hyperkeratosis of stomach squamous mucosa was seen in males after the recovery period. Kidney effects consistent with α2μ –globulin were seen in males but are not considered relevant to human health. U.S. EPA identified a LOAEL of 500 mg/kg/day based on body weight changes and clinical signs of toxicity. A NOAEL could not be established.
  - *Oral*: On a 90-day oral toxicity study of Exxsol D80 (containing distillates, petroleum, hydrotreated light (CAS# 64742-47-8)) in male and female HSD:SD(CD) rats, animals (10/sex/dose) were administered 0, 100, 500, or 1,000 mg/kg/day via gavage for 90 days. An additional 10 rats/sex were administered the high dose for 90 days followed by a 28-day recovery period before sacrifice. No effects on mortality, clinical signs, body weight, food consumption, eyes, hematology, clinical chemistry, organ weights, or gross an histologic pathology were seen. Kidney effects consistent with α2μ –globulin were seen in males but are not considered relevant to human health. In the liver, minimal centrilobular hypertrophy was seen at the mid and high doses in females and at the high dose in males, but reversed following recovery. Liver weights were slightly increased in both sexes at the two highest doses, but there were no other findings suggestive or hepatotoxicity. U.S. EPA identified a NOAEL of 1,000 mg/kg/day, the highest dose studied.
  - *Oral*: On a 90-day oral toxicity study of Isopar M (containing 100% distillates, petroleum, hydrotreated light (CAS# 64742-47-8)) in male and female Crl:CDBR Sprague-Dawley rats, animals (10-20 male and 10 female rats/dose) were administered 0, 100, 500, or 1,000 mg/kg/day via gavage for 13 weeks. An additional group received the high dose for 90 days and was allowed a 28-day recovery period. No effects on survival, clinical signs, body weight, food consumption, hematology, or clinical chemistry were seen. A dose related increase in liver weight was seen but was considered to be an adaptive change due to the absence of gross or microscopic findings in the liver. U.S. EPA identified a NOAEL of 1,000 mg/kg/day. The highest dose studied, based on the lack of effects.

- *Inhalation*: In a subchronic inhalation toxicity study of Exxsol D40 (containing distillates, petroleum, hydrotreated light (CAS# 64742-47-8) and naphtha (petroleum), hydrotreated heavy (CAS# 64742-48-9)) in male and female Sprague-Dawley rats, animals (70/sex/dose) were administered 0, 312, or 890 ppm (analytical) for 6 hours/day, 5 days/week, for 12 weeks (equivalent to 223 or 636 ppm after accounting for 5 days/week exposure[9]). Interim sacrifices were made at weeks 4 and 8. No mortality was observed. Ano-genital staining was seen in all treatment groups. Males in the high dose had slightly but significantly decreased body weight throughout the study. Relative liver weight was increased in both sexes at the high dose at all time periods. Relative kidney weight was increased in males at eh high dose at all time periods. No effects on hematology or clinical chemistry were seen. Kidney effects consistent with α2μ – globulin were seen in males but are not considered relevant to human health. U.S. EPA identified a NOAEC of > 890 ppm (analytical), which is equivalent to 636 ppm (3.7 mg/L[10]) after accounting for 5 days/week exposure.

<u>Jet Fuel JP-8 (No CAS#)</u>

- U.S. EPA 2011
  - *Oral*: In a 90-day oral toxicity study in male Sprague-Dawley rats, animals (10/dose) were administered 750, 1,500, or 3,000 mg/kg/day via gavage. Body weight was decreased at all doses. Relative liver weight and total bilirubin were increased in all dose groups. Relative spleen and testes weights were increased at the high dose. α2μ-globulin nephropathy was seen in all doses and chronic progressive nephrosis was seen at the high dose, but these effects are not considered relevant to human health. Urinary pH was decreased at the two highest doses, and blood creatinine was increased at the low and mid doses. Anal hyperplasia, dermatitis, and stomach hyperplasia were observed in all dose groups. Neutrophils were increased and lymphocytes were decreased in all dose groups, and platelets were increased at the highest dose. Aspartate aminotransferase and alanine aminotransferase were increased in all dose groups but the changes were not dose-dependent, and triglycerides were decreased at the high dose. U.S. EPA identified a LOAEL of 750 mg/kg/day based on changes in body weight, relative liver weight, bilirubin, and hematology. A NOAEL could not be established.
  - *Inhalation*: In a 90-day inhalation study in male and female Fischer 344 rats, animals (7-15 sex/dose) were continuously administered JP-5 at 0, 500, or 1,500 mg/m^3 (0, 0.5, or 1.5 mg/L[11]) for 90 days and were allowed to recover until approximately 24 months of age. No effects on clinical chemistry or hematology were seen. Body weight in males was significantly decreased at both doses, and absolute and relative kidney weights were increased. Urinary renal epithelial cell numbers were increased in males at both doses but reversed following a 2 week recovery. Males developed hyaline droplet formation, granular casts in the outer medulla, and an increase in severe lesions consistent with α2μ –globulin, which is not considered relevant to human health. In females, a dose related increase in hematopoiesis was seen. An increase in basophilic foci in liver was seen in males at both doses. U.S. EPA identified a LOAEC of 0.5 mg/L based on changes in body and kidney weight in males at the lowest dose. A NOAEC could not be established.
  - *Inhalation*: In a 90-day inhalation study in male and female C57BL/6 mice, animals were continuously administered JP-8 at 0, 500, or 1,500 mg/m^3 (0, 0. 5, or 1.5 mg/L

[9] 312 ppm * 5 days/7 days = 223 ppm
[10] mg/L = (ppm)(MW)/(24,450) = (636)(143)/(24,450) = 3.7 mg/L using average molecular weight for Exxsol D40 (U.S. EPA 2006)
[11] 150 mg/m^3 * 1 m^3/1000 L = 0.150 mg/L

(100/sex/dose) and were allowed to recover until approximately 24 months of age. Increase mortality due to necrotizing dermatitis associated with fighting was observed in males during the recovery period, but no treatment-related toxicity was seen in mice. ToxServices identified a NOAEC of 1.5 mg/L for this study based on the lack of treatment-related effects.

Hydrodesulfurized kerosene (CAS# 64742-81-0)

- U.S. EPA 2011
    - *Dermal*: In a 90-day oral toxicity study in male and female Sprague-Dawley rats, animal (12/sex/dose) were administered 0, 165, 330, or 495 mg/kg/day on skin 5 days/week for 13 weeks (0, 118, 236, or 354 mg/kg/day after accounting for 5 days/week exposure[12]). Skin irritation increased in severity with dose, and acanthosis, ulceration, parakeratosis, chronic active inflammation and hyperkeratosis were seen histologically. No effects on mortality, body weight, ophthalmic examination, functional observation battery, hematology, clinical chemistry microscopic examination, clinical chemistry or clinical signs of toxicity were seen. Absolute and relative spleen weights were increased in females at the highest dose. U.S. EPA identified a NOAEL of 495 mg/kg/day (354 mg/kg/day after accounting for 5 days/week exposure) based on the lack of adverse effects.
    - *Inhalation*: In a 4-week study in male and female Sprague-Dawley rats, animals (20/sex/dose) were administered 0 or 0.024 mg/L for 6 hours/day, 5 days/week (0.017 mg/L after accounting for 5 days/week exposure). There were no effects on mortality, body weight, hematology, clinical signs of toxicity, clinical chemistry, organ weight or histology. U.S. EPA identified a NOAEC of 0.024 mg/L (0.017 mg/L after accounting for 5 days/week exposure) based on the lack of effects.

Jet Fuel JP-5 (No CAS#)

- U.S. EPA 2011
    - *Inhalation*: In a 90-day study in male and female Fischer rats, animals (75/sex/dose) were continuously administered 0, 150, or 750 mg/m^3 (0, 0.15, or 0.75 mg/L) and serum chemistry, organ weights, and histology were measured after 90 days and for up to 21 months. In male rats, nephropathy (hyaline droplets, necrosis, and intratubular casts was seen at the high dose. Body weight was decreased and kidney weight was increased in males at the high dose. A decrease in red blood cells and hematocrit, and increase in BUN levels was seen in males at both doses. U.S. EPA identified a NOAEC of 0.15 mg/L and LOAEC of 0.75 mg/L based on changes in kidney weight in males.
    - *Inhalation*: In a 90-day study in female C57Bl/6 mice, animals (111 /dose) were continuously administered 0, 150, or 750 mg/m^3 (0, 0.15, or 0.75 mg/L) and serum chemistry, organ weights, and histology were measured after 90 days and for up to 21 months. Survival was decreased significantly by 20% in the high dose group. U.S. EPA identified a NOAEC of 0.15 mg/L and LOAEC of 0.75 mg/L based on decreased survival.
- Based on the weight of evidence, distillates, petroleum, hydrotreated light is not likely to be a repeated dose toxicant via the oral and dermal routes, with NOAELs far greater than 200 mg/kg/day in multiple studies. However, the lowest LOAEC in inhalation studies is 0.5 mg/L, which was identified in a 90-day study in F344 rats, based on a dose-related increase in hematopoiesis in females, and an increase in basophilic foci in the liver in males. Body weight decrease and kidney weight decrease were also observed in males, along with urinary renal

[12] 165 mg/kg/day * 5 days/7 days = 118 mg/kg/day

pathologies consistent with α2μ – globulin mechanisms which are not relevant to humans. In a mice 90-day study, the LOAEC was identified at 0.75 mg/L based on decreased survival.

Neurotoxicity (N)

***Group II Score (single dose)* (vH, H, M, or L):** DG

Distillates, petroleum, hydrotreated light were assigned a score of data gap for neurotoxicity (single dose) based on a lack of data for this endpoint.

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- Not classified as a developmental neurotoxicant (Grandjean and Landrigan 2006, 2014).
- No data were identified.

***Group II* Score (repeated dose)* (H, M, or L): L**

Distillates, petroleum, hydrotreated light were assigned a score of Low for neurotoxicity (repeated dose) based on a 90-day dermal toxicity study for a member of the Kerosene/Jet Fuel Category. GreenScreen® criteria classify chemicals as a Low hazard for neurotoxicity (repeated dose) when adequate data are available and adverse neurological effects are not see below the guidance value of 200 mg/kg/day for a dermal study (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- Not classified as a developmental neurotoxicant (Grandjean and Landrigan 2006, 2014).

Hydrodesulfurized kerosene (CAS# 64742-81-0)

- U.S. EPA 2011
  Dermal: In the 90-day oral toxicity study described above for systemic toxicity (repeated dose) in male and female rats, animals (12/sex/dose) were administered 0, 165, 330, or 495 mg/kg/day on skin 5 days/week for 13 weeks (0, 118, 236, or 354 mg/kg/day after accounting for 5 days/week exposure[13]). No effects on motor activity or functional observation battery were seen. ToxServices identified a NOAEL of 354 mg/kg/day for neurobehavioral effects.

Skin Sensitization (SnS) Group II* Score (H, M, or L): L

Distillates, petroleum, hydrotreated light were assigned a score of Low for skin sensitization based on a negative sensitization assay in guinea pigs for kerosene. GreenScreen® criteria classify chemicals as a Low hazard for skin sensitization when adequate data are available and are negative for sensitization, and the chemical is not present on authoritative or screening lists (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists

Kerosene, petroleum (CAS# 8008-20-6)

- U.S. EPA 2011
  - Kerosene was negative for skin sensitization in an assay in 10 guinea pigs (sex and strain not specified) that were administered 0.4 mL kerosene to the shaved skin for 6 hours under occlusion once per week for 3 weeks, followed by a challenge of 0.4 mL of a 1% solution in paraffin oil. No sensitization was observed.

[13] 165 mg/kg/day * 5 days/7 days = 118 mg/kg/day

Hydrodesulfurized kerosene (CAS# 64742-81-0)

- ESIS 2000
    - Hydrodesulfurized kerosene was not dermally sensitizing in a GLP compliant Buehler test in 10 male Hartley guinea pigs that were administered 0.4 mL of a 50% solution in paraffin oil once per week for 3 weeks, followed by a challenge of 0.4 mL of a 1% solution in paraffin oil. No sensitization was observed.

Respiratory Sensitization (SnR) Group II* Score (H, M, or L): DG
Distillates, petroleum, hydrotreated light were assigned a score of data gap for respiratory sensitization based on a lack of data for this endpoint (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists
- No data were identified.

Skin Irritation/Corrosivity (IrS) Group II Score (vH, H, M, or L): M
Distillates, petroleum, hydrotreated light were assigned a score of Moderate for skin irritation/corrosivity based on dermal irritation studies in rabbits. GreenScreen® criteria classify chemicals as a Moderate hazard for skin irritation/corrosivity when data indicate that the chemical should be classified as GHS Category 3 (mild irritant) (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists

Distillates, petroleum, hydrotreated light (CAS# 64742-47-8)

- ESIS 2000
    - Distillates, petroleum, hydrotreated light were not irritating in a GLP compliant dermal irritation study according to OECD Guideline 404 in rabbits (sex and strain not specified). No additional details were provided.
    - Distillates, petroleum, hydrotreated light were moderately irritating in a GLP compliant dermal irritation study according to OECD Guideline 404 in rabbits (sex and strain not specified). Scores of 1.7 for erythema and 0.7 for edema were obtained (observation time not reported).

Kerosene, petroleum (CAS# 8008-20-6)

- U.S. EPA 2011
    - When kerosene was administered to shaved, intact, and abraded skin of rabbits (sex and strain not specified) for 24 hours under occlusion, moderate to severe irritation was observed for up to 7 days after exposure.
    - Kerosene was not irritating to the skin of male and female New Zealand white rabbits in a dermal irritation study according to OECD Guideline 404. The mean scores for erythema and edema were 0.2 and 0.0, respectively, at 24, 48, and 72 hours.

Hydrodesulfurized kerosene (CAS# 64742-81-0)

- ESIS 2000
    - Hydrodesulfurized kerosene was irritating in a GLP compliant dermal irritation study in male New Zealand white rabbits treated for 24 hours with 0.5 mL to abraded and intact skin. The primary dermal irritation index was 4.4 and the substance was classified as irritating.
- Based on the weight of evidence, a score of moderate was assigned. Although kerosene and hydrosulfurized kerosene were irritating following dermal administration for 24 hours, GHS

guidelines specify a 4-hour test period for dermal irritation studies. GLP compliant OECD Guideline studies for distillates, petroleum, hydrotreated light report low-moderate irritation following a 4-hour exposure, with erythema and edema scores of 1.7 and 0.7. Based on GHS criteria, erythema scores of > 1.5 and <2.3 warrant classification as GHS Category 3, which corresponds to a score of moderate.

Eye Irritation/Corrosivity (IrE) Group II Score (vH, H, M, or L): L

Distillates, petroleum, hydrotreated light were assigned a score of Low for eye irritation/corrosivity based on a negative eye irritation study in rabbits. GreenScreen® criteria classify chemicals as a Low hazard for eye irritation/corrosivity when adequate data are available demonstrating that the chemical is not irritating, and the chemical is not present on authoritative or screening lists (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists

Distillates, petroleum, hydrotreated light (CAS# 64742-47-8)

- ESIS 2000
    - Distillates, petroleum, hydrotreated light were not irritating to the eyes of rabbits in a GLP compliant eye irritation study. No additional details were provided.

Kerosene, petroleum (CAS# 8008-20-6)

- U.S. EPA 2011; API 2000
    - Kerosene was mildly irritating to the eyes of 9 rabbits when 0.1 mL was instilled onto the corneal surface and washed after 20-30 seconds. The primary irritation scores at 1 hour were 0.7 in unwashed eyes and 2.0 in washed eyes. By 24 hours, scores returned to 0.

Hydrodesulfurized kerosene (CAS# 64742-81-0)

- ESIS 2000
    - Hydrodesulfurized kerosene was slightly irritating in a Draize test in 6 New Zealand white rabbits (sex not specified). After 24 hours, the mean primary irritation scores were 0.3 in unwashed eyes and 0.7 in washed eyes. After 48 hours, the mean primary irritation scores were 0.3 in unwashed eyes and 0.0 in washed eyes.
- Based on the weight of evidence, a score of low was assigned. Although few details were reported, distillates, petroleum, hydrotreated light was reported to be not irritating in a GLP compliant ocular irritation test, and studies of kerosene and hydrodesulfurized kerosene report at most slight irritation, with mean irritation scores up to 0.7 at 24 hours. As GHS criteria specify a score of $\geq$ 1 for corneal opacity or iritis and $\geq$ 2 for conjunctival redness or edema at 24 hours for classification, distillates, petroleum, hydrotreated light and the similar kerosene compounds are not considered to be irritating.

Ecotoxicity (Ecotox)

Acute Aquatic Toxicity (AA) Score (vH, H, M, or L): H

Distillates, petroleum, hydrotreated light was assigned a score of High for acute aquatic toxicity based on LC/EC_{50} values for distillates, petroleum, hydrotreated light, members of the Kerosene/Jet Fuel Category, and supporting chemicals. GreenScreen® criteria classify chemicals as a High hazard for acute aquatic toxicity when LC/EC_{50} values are greater than 1 to 10 mg/L (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists

Kerosene/Jet Fuel Category

- API 2010
    - The read-across LL/EL_{50} values for members of the kerosene Kerosene/Jet Fuel Category and supporting chemicals proposed as representative of potential aquatic toxicity range from 18 – 25 mg/L in fish, 1.4 – 21 mg/L in invertebrates, and 5.0 – 11 mg/L in algae.

Distillates, petroleum, hydrotreated light (CAS# 64742-47-8)

- U.S. EPA 2006
    - 96-hour LC_{50} (*Oncorhynchus mykiss*) = 2.9 mg/L
    - 48-hour LC_{50} (*Poecilia reticulate*) = 8.8 mg/L
    - 48-hour LC_{50} (*Danio rerio*) = 7.5 mg/L
    - 96-hour LC_{50} (*Oncorhynchus mykiss*) = 2.4 mg/L
    - 96-hour LC_{50} (*Lepomis macrochirus*) = 5.9 mg/L
    - 96-hour LC_{50} (*Oncorhynchus mykiss*) = 2.6 mg/L
    - 96-hour LC_{50} (*Lepomis macrochirus*) = 2.2 mg/L

Chronic Aquatic Toxicity (CA) Score (vH, H, M, or L): H

Distillates, petroleum, hydrotreated light were assigned a score of High for chronic aquatic toxicity based on a 21-day reproduction study in *Daphnia magna* for a member of the Kerosene/Jet Fuel Category. GreenScreen® criteria classify chemicals as a High hazard for chronic aquatic toxicity when chronic aquatic toxicity values are greater than 0.1 to 1.0 mg/L (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists

Hydrodesulfurized kerosene (CAS# 64742-81-0)

- U.S. EPA 2011
    - In a 21-day reproduction test according to OECD Guideline 211 in *Daphnia magna*, the EL_{50} values were 0.89 mg/L for reproduction and 0.81 mg/L for immobilization. The NOELR and LOELR were 0.48 and 1.2 mg/L, respectively.

Environmental Fate (Fate)

Persistence (P) Score (vH, H, M, L, or vL): M

Distillates, petroleum, hydrotreated light was assigned a score of Moderate for persistence based on experimental biodegradation tests for members of the Kerosene/Jet Fuel Category and supporting chemicals. GreenScreen® criteria classify chemicals as a Moderate hazard for persistence when the half-life in soil is 16 to 60 days (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists

Distillates, petroleum, hydrotreated light (CAS# 64742-48-8)

- ESIS 2000
    - In a GLP compliant biodegradation test according to OECD Guideline 301D (Ready Biodegradability: Closed Bottle Test), distillates, petroleum, hydrotreated light achieved 4% biodegradation after 28 days and was considered to be not readily biodegradable. Authors note that OECD Guideline 301F (Ready Biodegradability" Closed Bottle Test) is more suited for substances with poor water solubility.
        - In a GLP compliant biodegradation test according to OECD Guideline 301D (Ready Biodegradability: Closed Bottle Test), distillates, petroleum, hydrotreated

light achieved 11% biodegradation after 28 days and was considered to be not readily biodegradable. Authors note that OECD Guideline 301F (Ready Biodegradability" Closed Bottle Test) is more suited for substances with poor water solubility.

  - In a GLP compliant biodegradation test according to OECD Guideline 301D (Ready Biodegradability: Closed Bottle Test), distillates, petroleum, hydrotreated light achieved 12% biodegradation after 28 days and was considered to be not readily biodegradable. Authors note that OECD Guideline 301F (Ready Biodegradability" Closed Bottle Test) is more suited for substances with poor water solubility.
  - Distillates, petroleum, hydrotreated light are expected to partition to water (31.5-69.1%), soil (1.5-53.8%), air (5.0-26.9%), and sediment (0.9-25.1%).
- U.S. EPA 2011
  - Hydrocarbon components of distillates, petroleum, and hydrotreated light are likely to degrade. Distillates, petroleum, hydrotreated light are classified as P1 (low)-P2 (moderate) for persistence.

Kerosene, petroleum (CAS# 8008-20-6)

- U.S. EPA 2011
  - Kerosene achieved 58.6% biodegradation in 28 days in a test according to OECD Guideline 301F (Manometric respirometry) and was considered to be inherently but not readily biodegradable. No additional details were provided.

Diesel fuel (CAS# 68334-30-5)

- U.S. EPA 2011
  - Low sulfur and Nigerian diesel fuel achieved 60 and 57.5%, respectively theoretical BOD in 28 days in a manometric respirometry (OECD Guideline 301F test.

JP-4 (heavy kerosene) (CAS# 50815-00-4)

- U.S. EPA 2011
  - JP-4 has a half-life of 3.5 weeks in a clay soil at 27 °C.
- Based on the weight of evidence, a score of moderate was assigned. Distillates, petroleum, hydrotreated light achieved only 4-12% biodegradation in OECD Guideline 301D tests, but OECD Guideline 301F is better suited for water-insoluble substances (OECD 1992). In 301F tests, kerosene achieved 58.6% degradation and diesel fuel achieved 57.5-60% degradation in 28 days, indicating that chemicals in this class are inherently but not readily biodegradable. An experimental half-life of 3.5 weeks in soil for JP-4 supports a score of moderate.

Bioaccumulation (B) Score (vH, H, M, L, or vL): *vH*

Distillates, petroleum, hydrotreated light were assigned a score of Very High for bioaccumulation based on its estimated BCF values presence on a screening list. GreenScreen® criteria classify chemicals as a Very High hazard for bioaccumulation when estimated BCF values are > 5,000 or the chemical is classified as Bioaccumulative on Environment Canada's DSL (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Environment Canada - Domestic Substances List (DSL): Substances that are Bioaccumulative

Distillates, petroleum, hydrotreated light (CAS# 64742-48-8)

- U.S. EPA 2011
  - Distillates, petroleum, hydrotreated light are expected to have B1 (low)-B3 (high) bioaccumulation potential. Estimated BCF values for representative hydrocarbon structures range from 150.2 - 57,000.

Jet Fuel JP-8 (No CAS#)

- ESIS 2000
    - In bioaccumulation assays in *J. floridea* (128 days) and *S. gairdneri* (112 days) experimental BCFs of 130-159 and 61-115, respectively, for JP-8 were obtained.
- Based on the weight of evidence, a score of very high was assigned. No data were available for distillates, petroleum, hydrotreated light, but it is classified as bioaccumulative on Environment Canada's DSL and estimated BCF values range from 150.2 - 57,000 for representative hydrocarbon structures. In addition, the estimated Log K_{ow} ranges from 3.7-8.0, which suggests potential for bioaccumulation. As distillates, petroleum, hydrotreated light are a complex mixture of hydrocarbons, a score of very high was assigned to account for the possibility of a high proportion of bioaccumulative hydrocarbons in a given mixture. Classification as Bioaccumulative on Environment Canada's DSL also supports a score of very high. Confidence in this score is reduced because it is based on a screening list and estimated data.

Physical Hazards (Physical)

Reactivity (Rx) Score (vH, H, M, or L): L

Distillates, petroleum, hydrotreated light were assigned a score of low for reactivity based its HMIS rating for physical hazards. GreenScreen® criteria classify chemicals as a low hazard for reactivity when the chemical is not explosive, reactive with water, or self-reactive (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists
- EMSDIASUM 2014
    - Distillates, petroleum, received an HMIS rating of 0 for physical hazards (Minimal Hazard: Materials that are normally stable, even under fire conditions, and will NOT react with water, polymerize, decompose, condense, or self-react. Non-Explosives. (Paint.org 2014))

Flammability (F) Score (vH, H, M, or L): M

Distillates, petroleum, hydrotreated light were assigned a score of moderate for flammability based on its GHS classification and presence on an authoritative list. GreenScreen® criteria classify chemicals as a moderate hazard for flammability when data indicate that the chemical is classified as GHS Category and the chemical is classified as U.S. DOT 49 CFR§172.101 Hazard/Division 3, Packing Group III (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* U.S. DOT 49 CFR§172.101 Hazard/Division 3, Packing Group I, II, III
    - *Screening:* Not present on any screening lists
- ESIS 2000
    - Distillates, petroleum, hydrotreated light have a flash point of 58 °C.
    - Distillates, petroleum, hydrotreated light have a flash point of >65 °C.
    - Distillates, petroleum, hydrotreated light have a flash point of 77 °C.
- U.S. DOT 49 CFR§172.101 (U.S. DOT 2008)
    - Petroleum distillates are classified as U.S. DOT 49 CFR§172.101 Hazard/Division 3, Packing Group I, II, III. Per U.S. DOT 49 CFR§173.121, materials with a flash point > 23 °C and < 60 °C meet criteria for Packing Group III (U.S. DOT 2014).
- Based on the weight of evidence, a score of moderate was assigned. The most conservative flash point for distillates, petroleum, and hydrotreated light is 58 °C, which corresponds to GHS

Category 3 and a score of moderate. Distillates, petroleum, hydrotreated light, is also classified as U.S. DOT 49 CFR§172.101 Hazard/Division 3, Packing Group III, which also corresponds to a score of moderate.

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APPENDIX A: Hazard Benchmark Acronyms
(in alphabetical order)

(AA) Acute Aquatic Toxicity

(AT) Acute Mammalian Toxicity

(B) Bioaccumulation

(C) Carcinogenicity

(CA) Chronic Aquatic Toxicity

(D) Developmental Toxicity

(E) Endocrine Activity

(F) Flammability

(IrE) Eye Irritation/Corrosivity

(IrS) Skin Irritation/Corrosivity

(M) Mutagenicity and Genotoxicity

(N) Neurotoxicity

(P) Persistence

(R) Reproductive Toxicity

(Rx) Reactivity

(SnS) Sensitization- Skin

(SnR) Sensitization- Respiratory

(ST) Systemic/Organ Toxicity

APPENDIX B: Results of Automated GreenScreen® Score Calculation for Distillates, Petroleum, Hydrotreated Light (CAS #64742-47-8)

TOXSERVICES
TOXICOLOGY RISK ASSESSMENT CONSULTING

GREEN SCREEN FOR SAFER CHEMICALS

GreenScreen® Score Inspector

Table 1: Hazard Table

			Group I Human					Group II and II* Human								Ecotox		Fate		Physical	
			Carcinogenicity	Mutagenicity/Genotoxicity	Reproductive Toxicity	Developmental Toxicity	Endocrine Activity	Acute Toxicity	Systemic Toxicity		Neurotoxicity		Skin Sensitization*	Respiratory Sensitization*	Skin Irritation	Eye Irritation	Acute Aquatic Toxicity	Chronic Aquatic Toxicity	Persistence	Bioaccumulation	Reactivity	Flammability
Table 2: Chemical Details									S	R *	S	R *	*	*								
Inorganic Chemical?	**Chemical Name**	**CAS#**	**C**	**M**	**R**	**D**	**E**	**AT**	**STs**	**STr**	**Ns**	**Nr**	**SNS***	**SNR***	**IrS**	**IrE**	**AA**	**CA**	**P**	**B**	**Rx**	**F**
No	Distillates, petroleum, hydrotreated light	64742-47-8	M	*M*	L	L	DG	L	DG	M	DG	L	L	DG	M	L	H	H	M	*vH*	L	M

Table 3: Hazard Summary Table

Benchmark	a	b	c	d	e	f	g
1	No	No	No	No	No		
2	Yes	No	No	Yes	Yes	No	No
3	STOP						
4	STOP						

Table 4

Chemical Name	Preliminary GreenScreen® Benchmark Score
Distillates, petroleum, hydrotreated light	2

Note: Chemical has not undergone a data gap assessment. Not a Final GreenScreen™ Score

Table 6

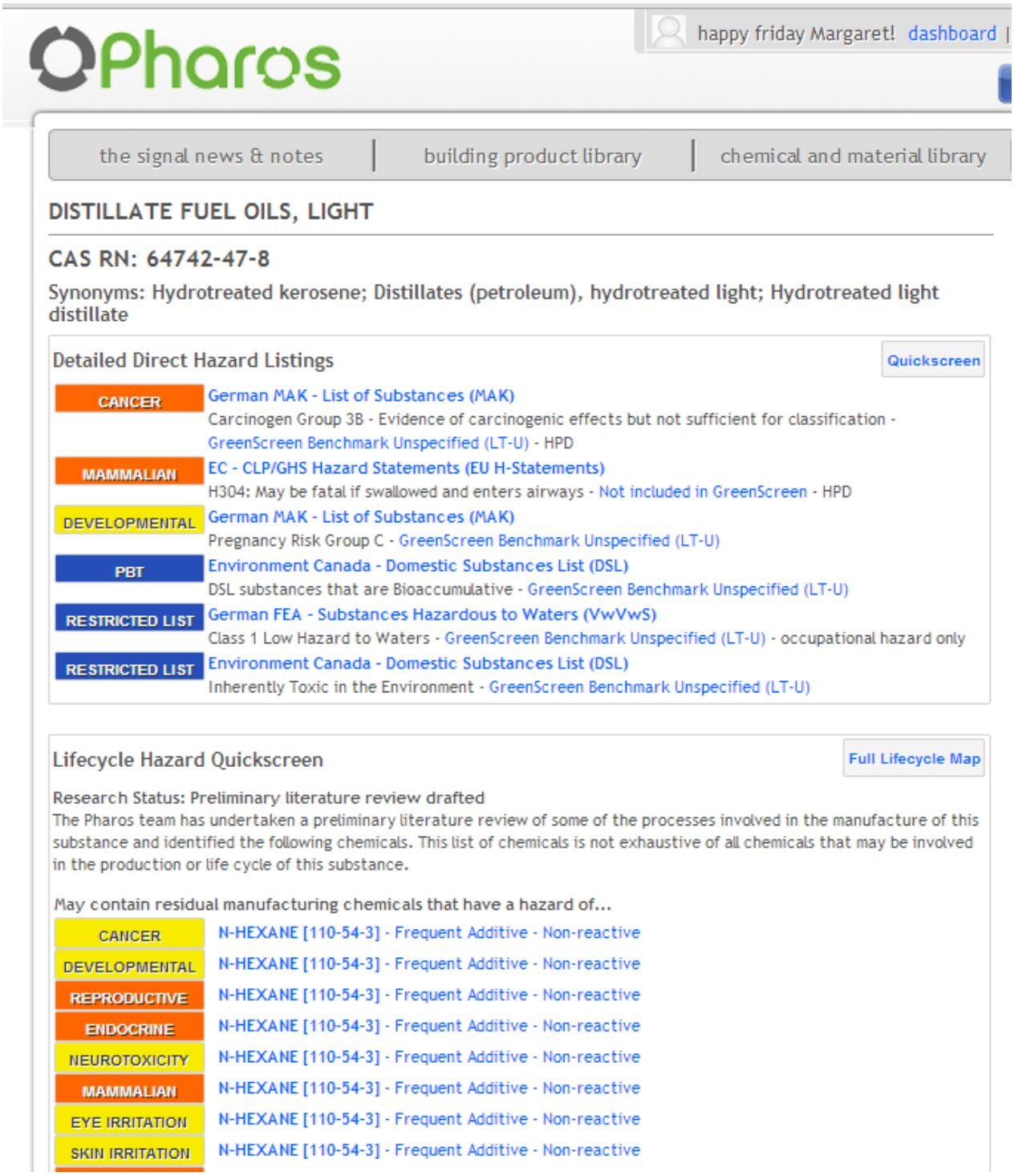
Chemical Name	Final GreenScreen® Benchmark Score
Distillates, petroleum, hydrotreated light	2

After Data gap Assessment
Note: No Data gap Assessment Done if Preliminary GS Benchmark Score is 1.

Table 5: Data Gap Assessment Table

Datagap Criteria	a	b	c	d	e	f	g	h	i	j	bm4	End Result
1												
2	Yes	Yes	Yes	Yes	Yes							2
3												
4												

APPENDIX C: Pharos Output for Distillates, Petroleum, Hydrotreated Light (CAS #64742-47-8)



Pharos

happy friday Margaret! dashboard |

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DISTILLATE FUEL OILS, LIGHT

CAS RN: 64742-47-8

Synonyms: Hydrotreated kerosene; Distillates (petroleum), hydrotreated light; Hydrotreated light distillate

Detailed Direct Hazard Listings — Quickscreen

CANCER	German MAK - List of Substances (MAK) Carcinogen Group 3B - Evidence of carcinogenic effects but not sufficient for classification - GreenScreen Benchmark Unspecified (LT-U) - HPD
MAMMALIAN	EC - CLP/GHS Hazard Statements (EU H-Statements) H304: May be fatal if swallowed and enters airways - Not included in GreenScreen - HPD
DEVELOPMENTAL	German MAK - List of Substances (MAK) Pregnancy Risk Group C - GreenScreen Benchmark Unspecified (LT-U)
PBT	Environment Canada - Domestic Substances List (DSL) DSL substances that are Bioaccumulative - GreenScreen Benchmark Unspecified (LT-U)
RESTRICTED LIST	German FEA - Substances Hazardous to Waters (VwVwS) Class 1 Low Hazard to Waters - GreenScreen Benchmark Unspecified (LT-U) - occupational hazard only
RESTRICTED LIST	Environment Canada - Domestic Substances List (DSL) Inherently Toxic in the Environment - GreenScreen Benchmark Unspecified (LT-U)

Lifecycle Hazard Quickscreen — Full Lifecycle Map

Research Status: Preliminary literature review drafted

The Pharos team has undertaken a preliminary literature review of some of the processes involved in the manufacture of this substance and identified the following chemicals. This list of chemicals is not exhaustive of all chemicals that may be involved in the production or life cycle of this substance.

May contain residual manufacturing chemicals that have a hazard of...

CANCER	N-HEXANE [110-54-3] - Frequent Additive - Non-reactive
DEVELOPMENTAL	N-HEXANE [110-54-3] - Frequent Additive - Non-reactive
REPRODUCTIVE	N-HEXANE [110-54-3] - Frequent Additive - Non-reactive
ENDOCRINE	N-HEXANE [110-54-3] - Frequent Additive - Non-reactive
NEUROTOXICITY	N-HEXANE [110-54-3] - Frequent Additive - Non-reactive
MAMMALIAN	N-HEXANE [110-54-3] - Frequent Additive - Non-reactive
EYE IRRITATION	N-HEXANE [110-54-3] - Frequent Additive - Non-reactive
SKIN IRRITATION	N-HEXANE [110-54-3] - Frequent Additive - Non-reactive

Licensed GreenScreen® Profilers

Distillates, Petroleum, Hydrotreated Light GreenScreen® Evaluation Prepared by:

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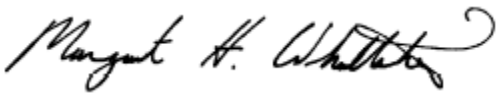
Distillates, Petroleum, Hydrotreated Light GreenScreen® Evaluation QC'd by:



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