

Alternatives Assessments and the GreenScreen for Safer Chemicals



A GLOBAL LEADER IN PUBLIC HEALTH AND SAFETY

**2015 Michigan Green Chemistry & Engineering 101 Workshop
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An Introduction

Our Values

NSF's Mission and History



Today

NSF Around the World



Capabilities

Services from NSF International



Our Mission



NSF International is dedicated to being the leading global provider of public health and safety-based risk management solutions while serving the interests of all stakeholders, namely the public, the business community and government agencies.

NSF International is a global, independent, public health and safety organization.

Our mission and focus has always been protecting and improving human health.

NSF helps people live safer.

We carry out this human health and safety mission by:



STANDARDS

Writing standards to promote food, drinking water, indoor air, dietary supplements, consumer products and environmental safety



CERTIFICATION

Certifying products to these standards



AUDITING

Conducting safety audits for the food, water and consumer goods industries



SUSTAINABILITY

Developing sustainability solutions



ISO

Certifying to ISO standards



TRAINING

Developing training and education programs

NSF International Hazard Assessment Services



12 Principles of Green Chemistry*



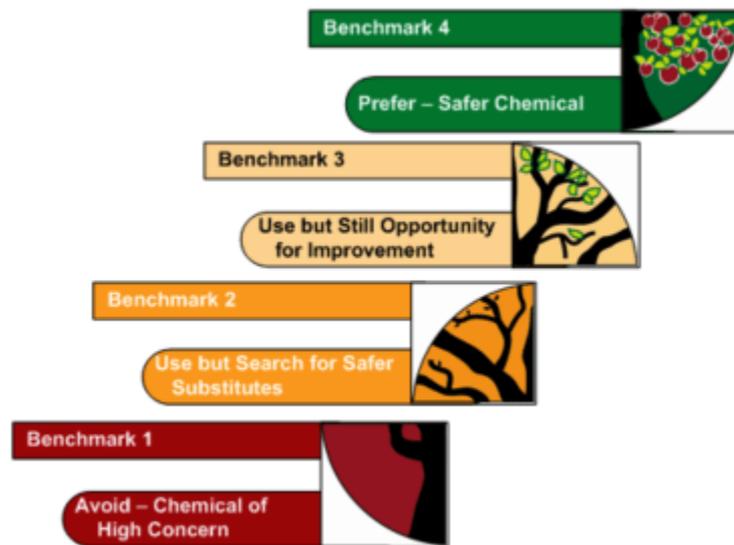
The GreenScreen™ focuses on 3 key principles of Green Chemistry

1. Prevention
2. Atom Economy
3. Less Hazardous Chemical Syntheses
4. Designing Safer Chemicals
5. Safer Solvents and Auxiliaries
6. Design for Energy Efficiency
7. Use of Renewable Feedstocks
8. Reduce Derivatives
9. Catalysis
10. Design for Degradation
11. Real-time analysis for Pollution Prevention
12. Inherently Safer Chemistry for Accident Prevention

* Anastas, P. T.; Warner, J. C.; Green Chemistry: Theory and Practice, Oxford University Press: New York, 1998, p.30. By permission of Oxford University Press

Clean Production Action – GreenScreen™

- An easy to use Benchmark Scoring System
- Allows easy comparisons
- Builds on US EPA, GHS and other international approaches
- Transparent
- Ties into Life Cycle Assessments and other sustainability tools



Who is Using the GreenScreen™

Manufacturers
NGO's
Retailers
Certification bodies
State Governments



The GreenScreen is a Hazard Assessment

It is **NOT** a risk assessment

Hazard is an inherent property that may result in harm

Exposure is a measure of duration and frequency

Risk reflects the probability of harm if exposure occurs

Risk = f (hazard, exposure)



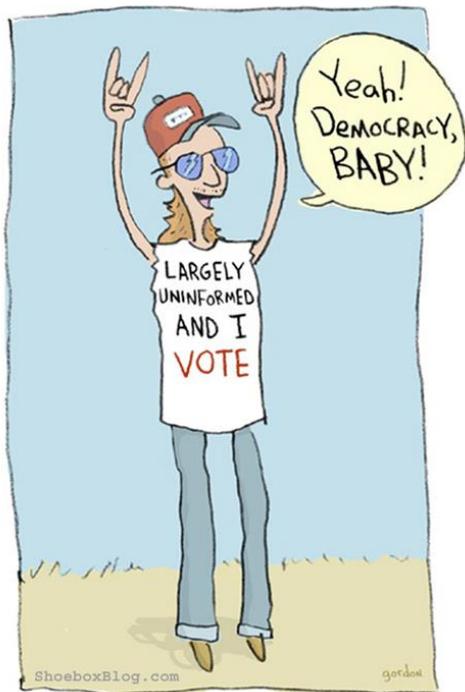
Risk and Hazard are Different Questions



**A risk assessment answers the question
“is it safe enough for the intended use?”**

**A hazard assessment answers the
question “which is inherently safer?”**

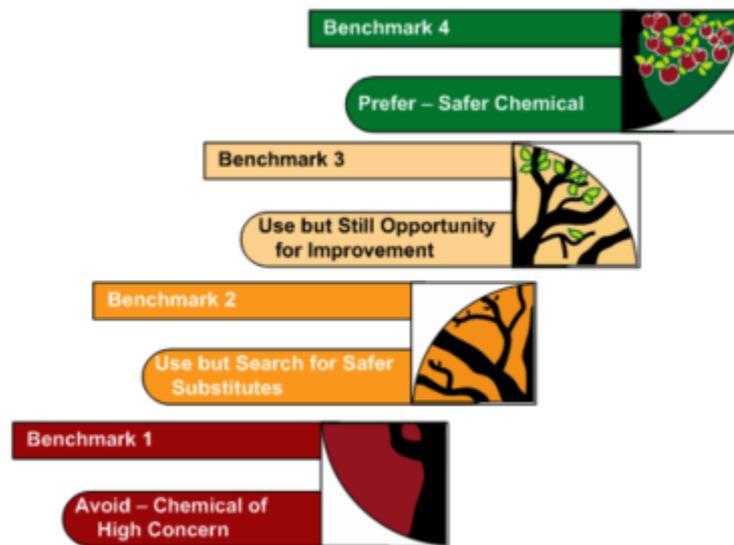
Goal to Avoid Regrettable Substitutions



We don't want to replace a chemical of concern with an unknown!

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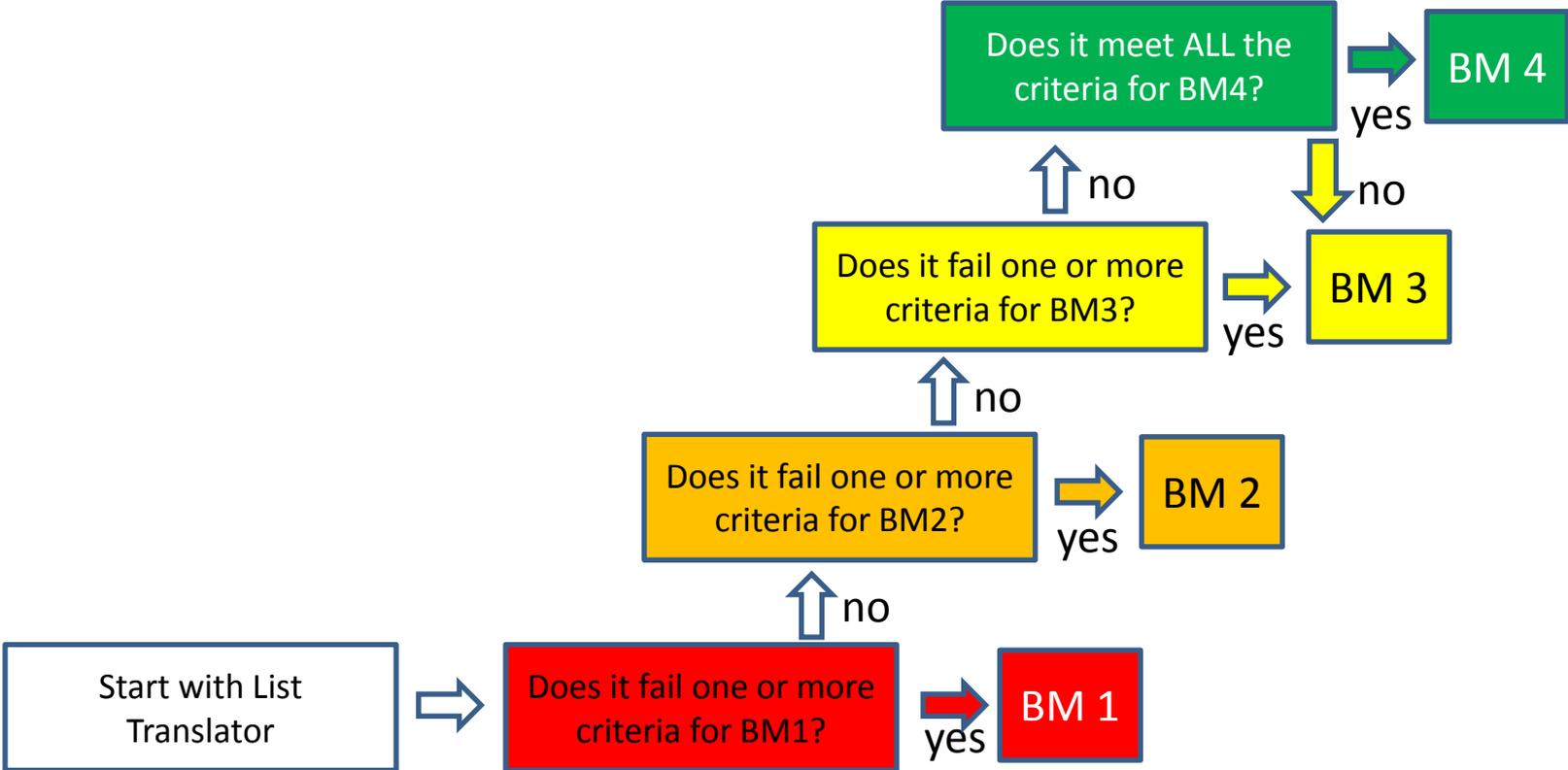


GreenScreen™ Hazard Summary Table

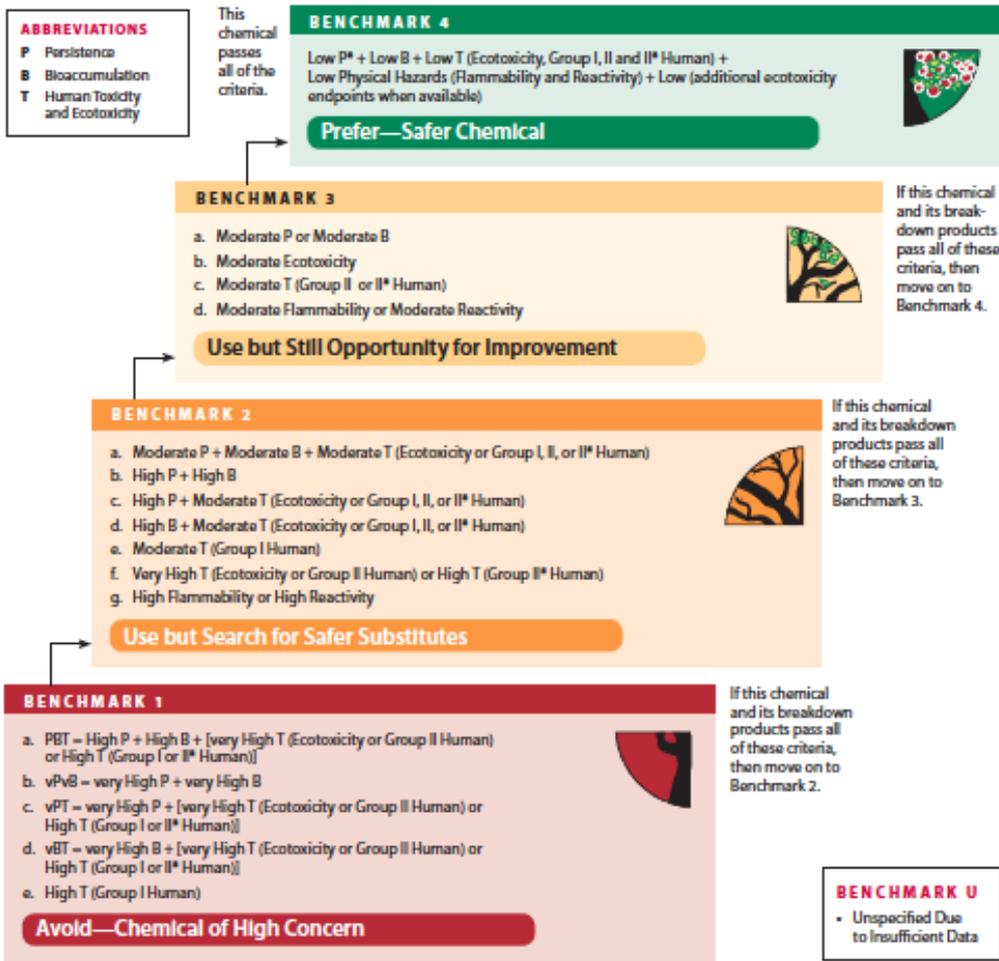
Green Screen Hazard Endpoints and Ratings																			
Group 1 Human					Group II and II* Human								Ecotox		Fate		Physical		
Carcinogenicity	Mutagenicity	Reproductive toxicity	Developmental toxicity	Endocrine activity	Acute toxicity	Systemic toxicity		Neurotoxicity		Skin sensitization*	Respiratory sensitization*	Skin irritation	Eye irritation	Acute aquatic toxicity	Chronic aquatic toxicity	Persistence	Bioaccumulation	Reactivity	Flammability
						S	R	S	R										
L	L	L	M	M	L	L	L	vH	H	L	L	L	L	H	H	vL	L	M	L

Endpoints are scored as very low (vL), low (L), moderate (M), high (H), or very high (vH). Bold letters represent greater confidence in the hazard ranking.

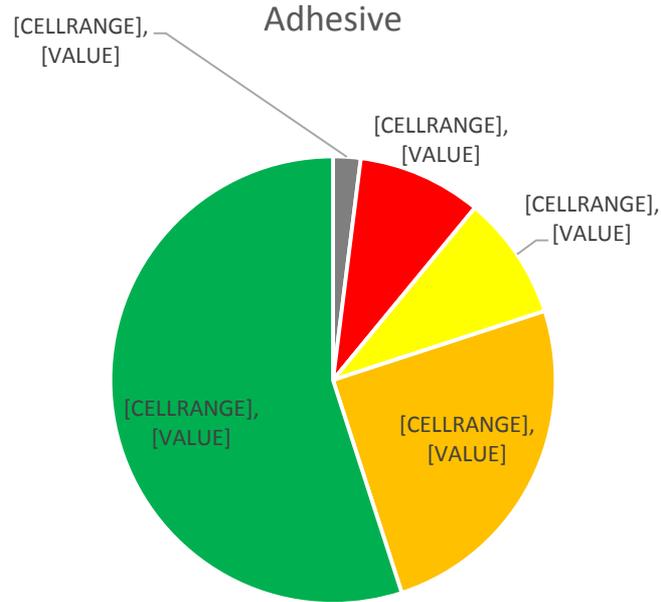
GreenScreen List Translator



Use Hazard Summary Table to Determine Benchmark Score



Mixtures



- No overall Benchmark
- Must include all constituents
- Disclosure best practices = 100 ppm (0.01%)

Mixtures

Chemical	CAS	% by weight	Benchmark	BM by %
Calcium carbonate	1317-65-3	30-45%	4	30-45%
Acetone	67-64-1	5-20%	2	5-20%
Petroleum distillates	64742-89-8	5-20%	1	10-46%
Toluene	108-88-3	5-20%	1	
Dichloromethane	75-09-2	0-5%	1	
Methyl ethyl ketone	78-93-3	0-1%	1	

Special Case Impurities



Chemical	CAS	Concentration in final product (ppm)	LT Results	Reason for Inclusion
Sulfur	7704-34-9	20	LT-U	Impurity in petroleum distillates
Nickel	7440-02-0	20	LT-1	Impurity in petroleum distillates

Known and special case impurities < 100 ppm in the parent product should also be reported with their List Translator Results (or full GreenScreen)

GreenScreen™ List Translator

- The List Translator (LT) tool tells if a chemical is a known or possible Benchmark 1 chemical, based on **authoritative** lists.
- Automated
- LT results can include:
 - **LT-1** (expected BM1)
 - **LT-P1** (possible BM1, list crossover)
 - LT-U (undetermined from the lists)
- Only a full GreenScreen™ can tell you if a chemical is better than BM1 (i.e. BM2, BM3, or BM4)

Authoritative lists include:

AOEC

DOT

EPA-AMT

EU-CMR

EU-PBT

EU-Hazard statements

IARC

Prop 65

MAK

...and more (see full list on CPA website)

Pharos – Automated List Translator

Pharos Project: Chemicals and Materials - Windows Internet Explorer

https://www.pharosproject.net/material/cher

NSF International Intranet NSF Applications Portal Home ProdTrack Tool Pharos Project: Chemi...

Convert Select

Pharos Building Products Chemicals and Materials Certifications Dashboard Logout

Dashboard / Chemicals and Materials

Chemicals and Materials

About the CML Search Chemicals and Materials (37,602) Search Hazard Lists (66)

The Chemical and Material Library (CML) is an online catalog of 37,602 chemicals, polymers, metals, and other substances. It identifies key health and environmental information using:

- 41 authoritative scientific lists for specific human and environmental health hazards
- 20 restricted substance lists
- GreenScreen List Translator scores

The CML also characterizes the process chemistry used to produce 1,119 substances and screens woods against 5 endangered species lists.

chemicals: 35,427

variants: 134

biobased materials: 1,475

unregistered materials: 94

compound groups: 472

Hazard Levels and Endpoints

What is the purpose of the Pharos Chemical and Material Library?

What hazard endpoints does Pharos track?

What do the hazard and priority levels mean?

Are exposure and risk included?

GreenScreen

What is the GreenScreen?

What is a GreenScreen Assessment?

Where do I find GreenScreen Assessments?

How does Pharos use the GreenScreen List Translator?

Key

Pharos – Automated List Translator

The screenshot displays the Pharos web application interface within a Windows Internet Explorer browser window. The browser's address bar shows the URL <https://www.pharosproject.net/material/cher>. The application header includes the Pharos logo and navigation links for Building Products, Chemicals and Materials, Certifications, Dashboard, and Logout. The current page is titled "Chemicals and Materials" and shows search results for the term "50-00-0".

Search Results:

CAS RN	Material Name	Hazard			GreenScreen
		Substance	Residual	Manufacturing	
71550-00-0	Chromate(1-), bis[3-[(5,8-dichloro-1-hydroxy-2-naphthalenyl)azo]-4-hydroxybenzenesulfonamidato (2-)]-, sodium	●			LT-UNK
84650-00-0	Coffee, Coffea arabica, ext.				
50-00-0	FORMALDEHYDE	●	●	●	LT-1
(compound group)	Formaldehyde based binders	●	●	●	
(compound group)	Formaldehyde compounds	●	●	●	
50-00-0 (variant)	Formol	●	●	●	LT-1
13150-00-0	n-Alcohol(C12-C18)ethersulfates (2-3 EO)	●			LT-P1

Search Filters:

- Search term: 50-00-0
- Type: Any type
- Used in Product Category: Any category
- Has a full GreenScreen assessment
- Restricted lists include: Add
- Restricted lists do not include: Add
- Include residuals in selected filters above

Buttons: About the CML, Search Chemicals and Materials (7), Search Hazard Lists (66), Apply Filters

Pharos – Automated List Translator

Pharos Project : Materials : FORMALDEHYDE - Windows Internet Explorer

https://www.pharosproject.net/material/show

NSF International Intranet NSF Applications Portal Home ProdTrack Tool Pharos Project : Materi...

Convert Select

Pharos Building Products Chemicals and Materials Certifications Dashboard Logout

Direct Hazards:

- CANCER**  Intl Agency for Rsrch on Cancer - Cancer Monographs - Group 1: Agent is carcinogenic to humans **+ 13**
- DEVELOPMENTAL**  German MAK - List of Substances - Pregnancy Risk Group C
- GENE MUTATION**  EC - CLP/GHS Hazard Statements - H341 Suspected of causing genetic defects **+ 2**
- MAMMALIAN**  US EPA - Extremely Hazardous Substances - Extremely Hazardous Substances **+ 17**
- EYE IRRITATION**  Japan METI/MOE - GHS Classifications - Serious eye damage / eye irritation - Category 2A
- SKIN IRRITATION**  EC - CLP/GHS Hazard Statements - H314 Causes severe skin burns and eye damage **+ 4**
- SKIN SENSITIZE**  German MAK - List of Substances - Sensitizing Substance Sh - Danger of skin sensitization **+ 3**
- ACUTE AQUATIC**  Korea NIER - GHS Classification - Hazardous to the aquatic environment (acute) - Category 1 [H400 - Very toxic to aquatic life] **+ 1**
- FLAMMABLE**  Québec CSST - WHMIS 1998 Classifications - Class B1 - Flammable gases **+ 1**
- RESTRICTED LIST**  ChemSec - Substitute List - Classified CMR (Carcinogen, Mutagen &/or Reproductive Toxicant) **+ 15**
- PBT** US EPA - PPT Chemical Action Plans - Low environmental persistence - TSCA Criteria met
- RESPIRATORY**  AOEC - Asthmagens - Asthmagen (AG) - generally accepted **+ 3**

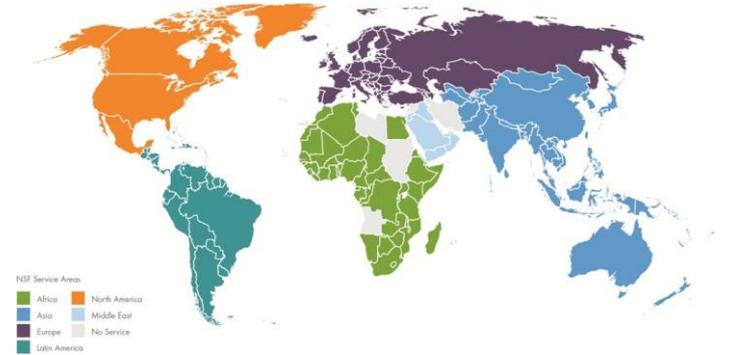
My Project Lists

[Click to view 13 more listings.](#)

No project lists available. Lists can be added to existing projects on your account. Visit your dashboard for more information.

Drivers for the GreenScreen™

- Preferred purchasing plans (electronics, textiles, automotive, building products)
- Corporate responsibility / due diligence
- International sales
- Voluntary Standards
 - LEED certification – materials optimization credits
 - Health Product Declarations (HPDs)
 - TCO Certification for IT products
- State regulations
 - California, Maine, Washington
- Customers want transparency



Challenges for Using the GreenScreen™

Issues

1. Getting supplier disclosures can be challenging
2. Doing full GreenScreens requires training or outsourcing
3. Knowing what to do if your product has BM1 chemicals in it
4. It's not always practical to run GreenScreen on an entire inventory

Solutions

1. Suppliers are more comfortable disclosing formulations to a third-party under NDA
2. Training is offered by Clean Production Action and licensed profilers
3. Licensed profilers can help find data, identify analogs, perform modeling
4. Licensed profilers can help prioritize efforts and take “family” approaches



Exercise – Making Informed Decisions

SCENARIO: You have a Benchmark 1 chemical of concern that you need to replace. You are considering two alternatives that are both Benchmark 2 chemicals. The chemical of concern is an additive in a polymer.

OBJECTIVE: Determine the best substitute for the chemical of concern.

INSTRUCTIONS: Review the Hazard Summary Table below and answer the three questions on the next page.

Chemical	CAS#	%	GS BM	Group I Human					Group II and II* Human								Ecotox		Fate		Physical		
				C	M	R	D	E	AT	ST		N		SnS*	SnR*	IrS	IrE	AA	C A	P	B	Rx	F
										single	repeat*	single	repeat*										
Chemical 1	XXX-XX-X	100%	1	H	H	M	M	DG	vH	L	M	L	M	H	H	H	H	vH	vH	vH	vH	L	L
Alternative 1	XXX-XX-X	100%	2	L	M	L	L	DG	L	M	M	M	M	M	L	M	M	M	L	L	M	M	M
Alternative 2	XXX-XX-X	100%	2	M	DG	L	L	M	H	DG	DG	M	M	M	M	M	H	M	M	H	M	M	M

L = low hazard, M = moderate hazard, H = high hazard, vH = very high hazard, DG = data gap