Case Study

WHO Human Health Risk Assessment Toolkit: Chemical Hazards

Training on Risk Assessment of Chemicals at National Level in a Global Context

24-25 February 2011
Ministry of Environment, Yerevan, Armenia

Dr Kersten Gutschmidt, Public Health and Environment

World Health Organization

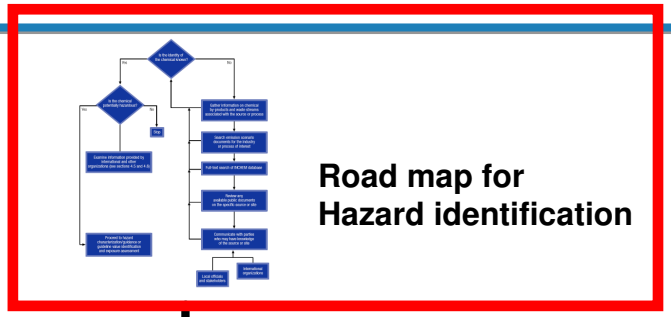
Example case study

Statement of problem:

- **Metal finishing facility discharges waste from plating operations into river for 24/7.**
- **River flows directly through community which is short distance downstream.**
- **River water is used for drinking, cooking, and bathing.**
- **Cadmium was identified as a by-product of chrome-plating operations.**

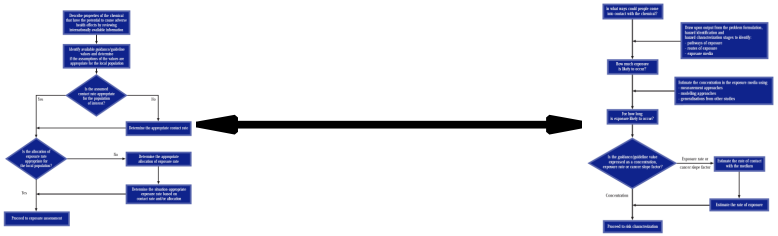
⇒ **What are the potential health risks of discharges into the river?**

Roadmaps by stage of the risk assessment

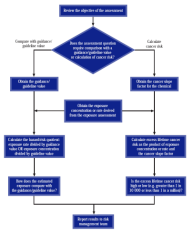


Road map for Hazard identification

Road map for Hazard characterization/ Guidance value identification



Road map for Exposure assessment



Road map for Risk characterization

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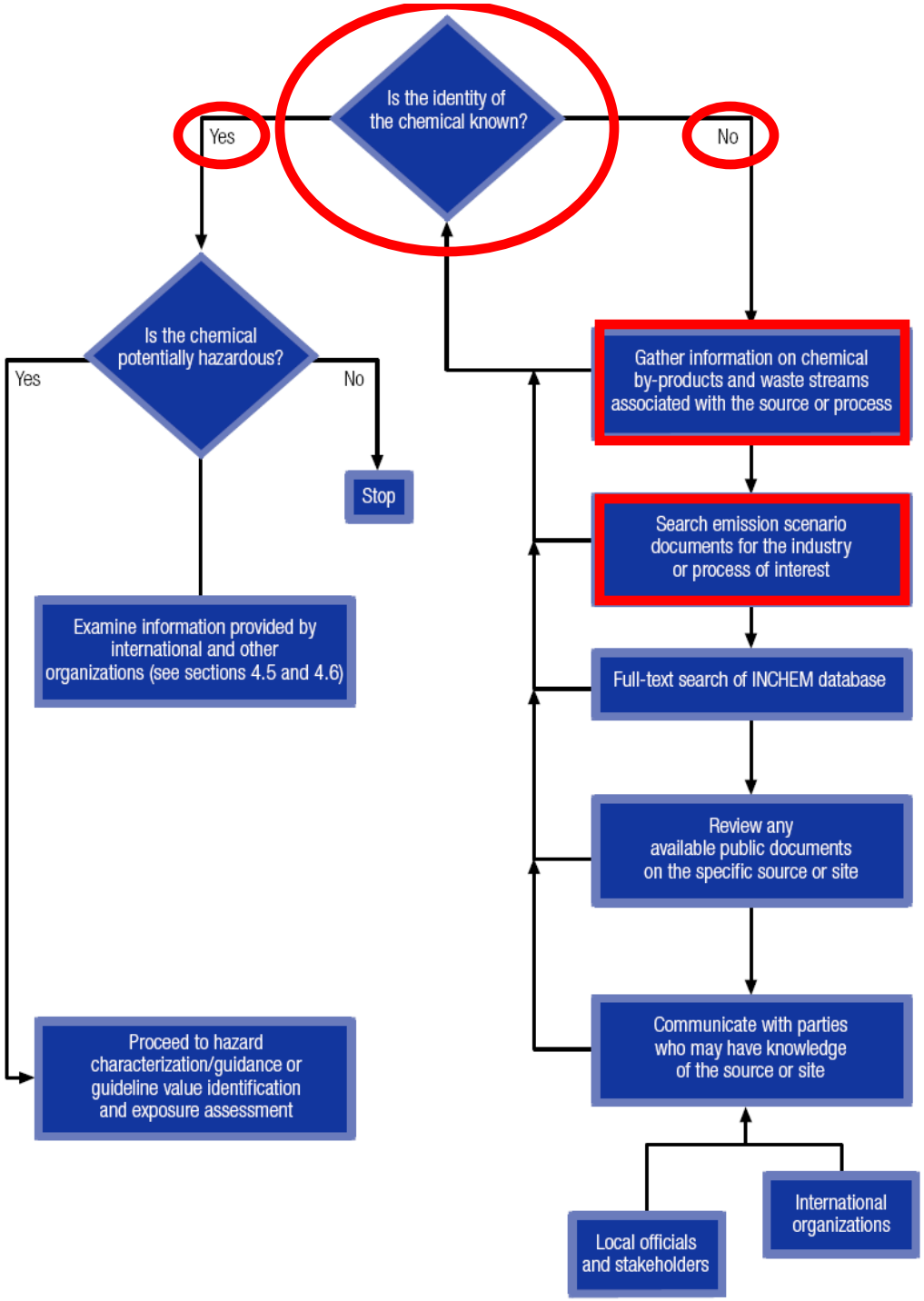
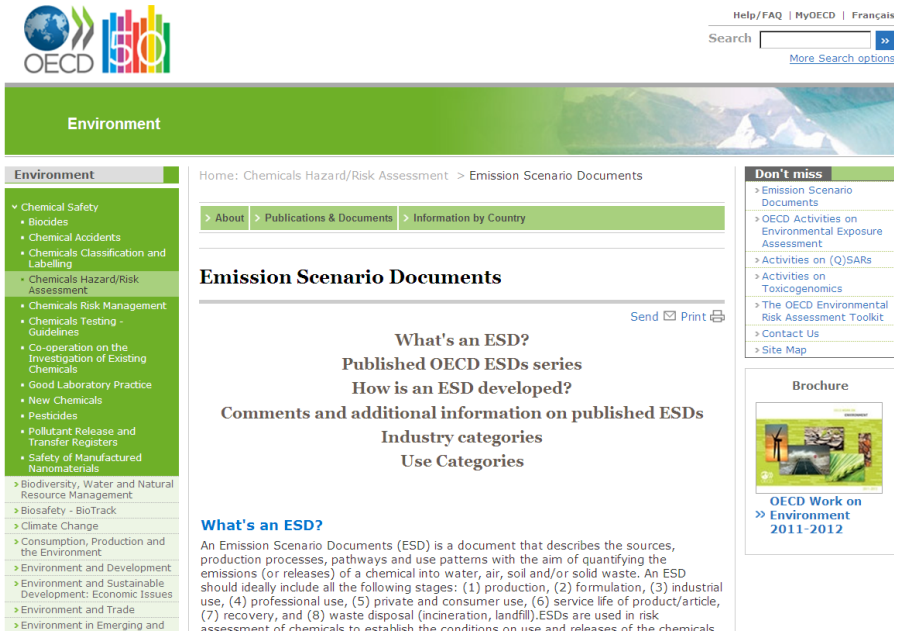
Roadmap for hazard identification



OECD – Emission Scenario Documents



Published OECD ESDs series:

- Series No. 1, Guidance Document on Emission Scenario Documents ENV/JM/MONO(2000)12 (2000)
- Series No. 2, Wood preservatives, (joint project with OECD Biocides Programme), Part 1 , Part 2 , Part 3 , Part 4 (2000)
- Series No. 3, Plastic Additives (2004, revised 2009)
- Series No. 4, Water Treatment Chemicals (2004)
- Series No. 5, Photographic Industry (2004)
- Series No. 6, Rubber Additives (2004)
- Series No. 7, Textile Finishing (2004)
- Series No. 8, Leather Processing (2004)
- Series No. 9, Photoresist Use in Semiconductor Manufacturing [2004 Revised January 2010]
- Series No. 10, Lubricants and Lubricant Additives (2004)
- Series No. 11, Automotive spray application (2004)
- Series No. 12, Metal finishing (2004)
- Series No. 13, Antifoulants main document and ANNEX (2005) (joint project with OECD Biocides Programme)
- Series No. 14, Insecticides for Stables and Manure Storage Systems (2006) (joint project with OECD Biocides Programme)
- Series No. 15, Kraft Pulp Mills (2006)
- Series No. 16, Non-Integrated Paper Mills (2006)
- Series No. 17, Recovered Paper Mills (2006)
- Series No. 18, Insecticides, acaricides and products to control other arthropods for household and professional uses (2008) (joint project with OECD Biocides Programme)
- Series No. 19, Complementing Guideline for Writing ESDs: The Life-Cycle Step "service-life" [NEW; July 2009]
- Series No. 20, Adhesive Formulation [NEW, April 2009]
- Series No. 21 Formulation of Radiation Curable Coatings, Inks and Adhesives [2009 Revised January 2010]
- Series No. 22 Coating Industry (Paints, Lacquers and Varnishes) [NEW; July 2009]
- Series No. 23 Pulp, Paper and Board Industry [NEW; July 2009]
- Series No. 24 Transport and Storage of Chemicals [NEW; July 2009]
- Series No. 25 Chemicals Used in the Electronics Industry [New; September 2010]
- Series No. 26 Blending of Fragrance Oils into Commerical and Consumer Products [New; September 2010]

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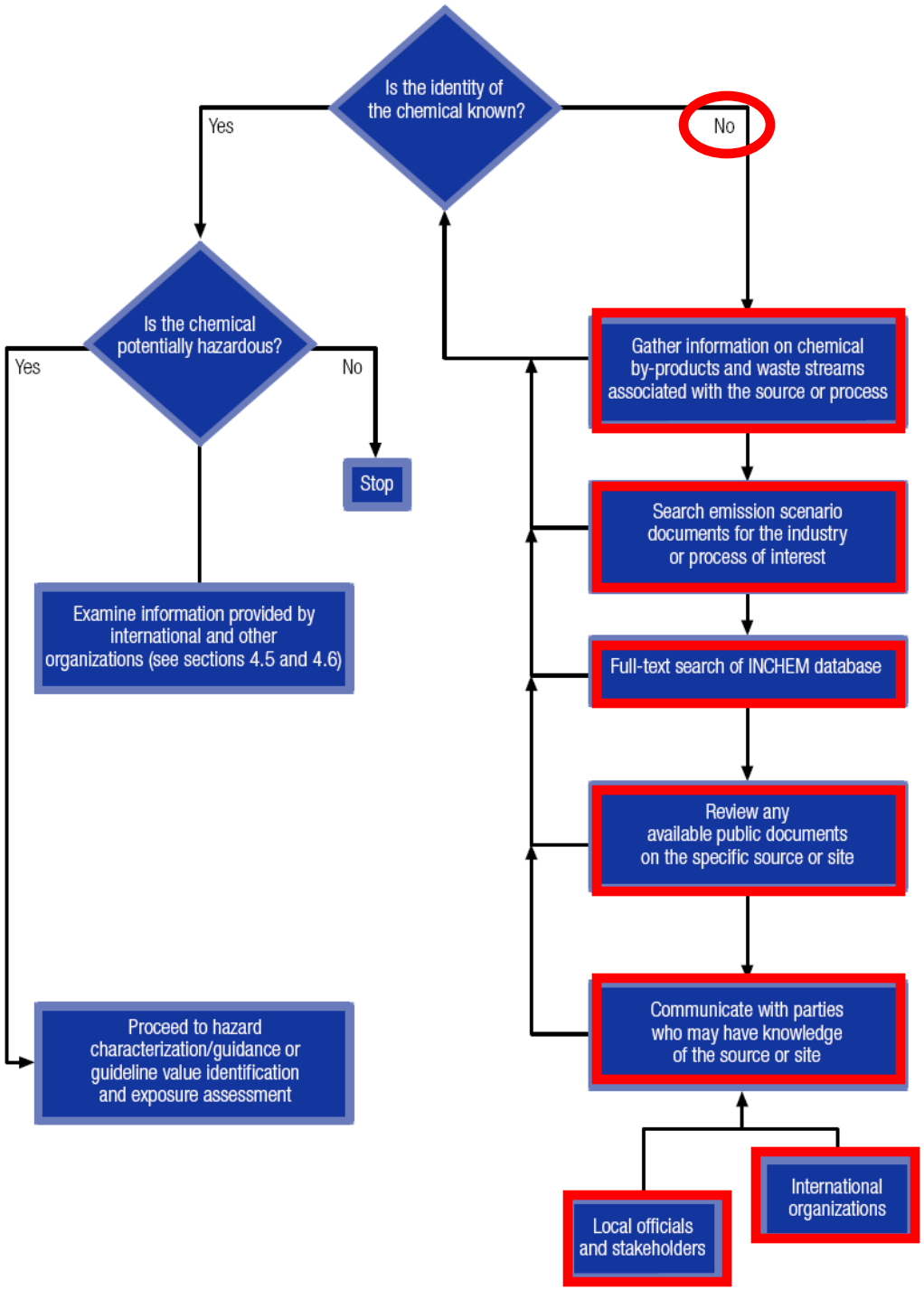
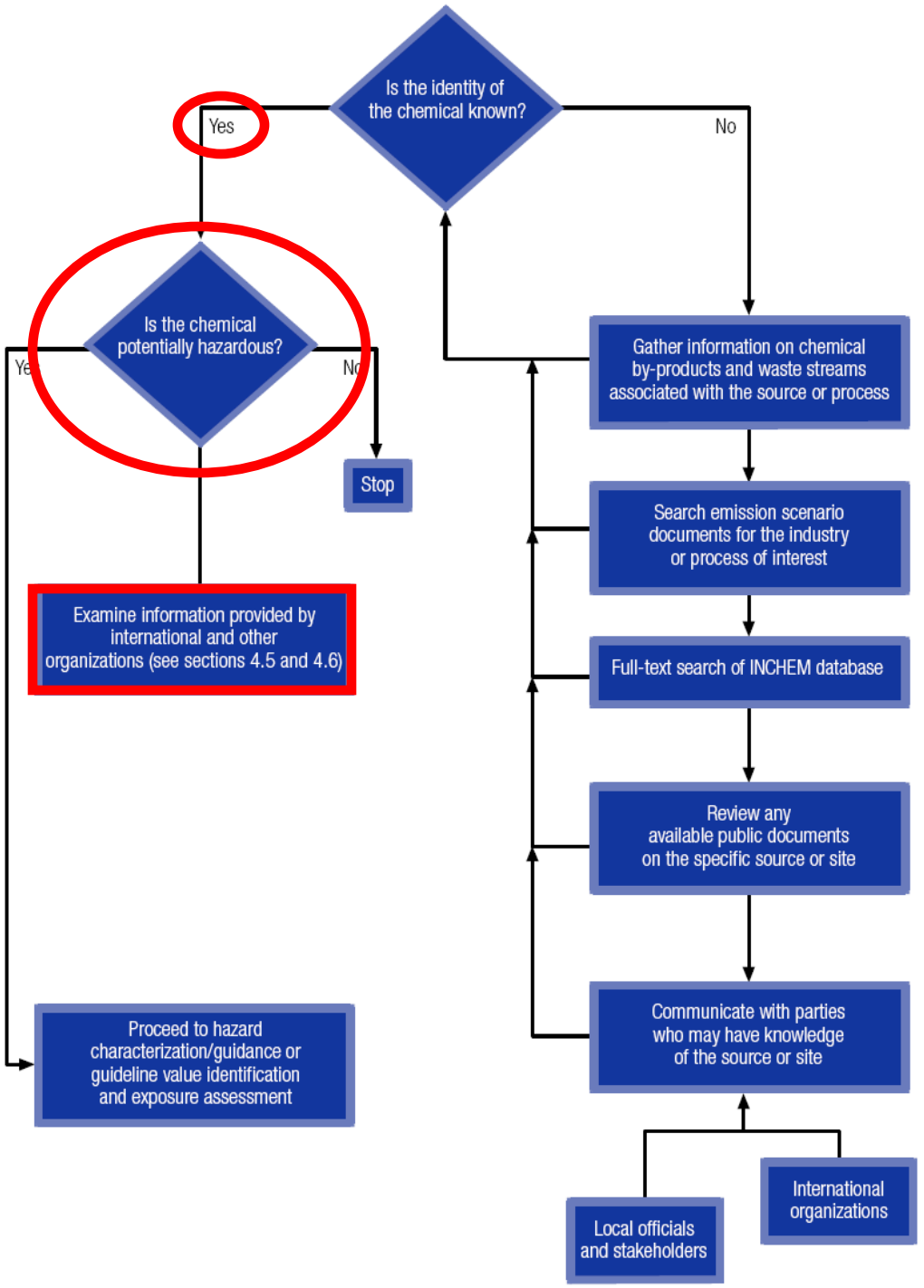
Roadmap for hazard identification



Roadmap for hazard identification



CADMIUM ICSC: 0020

Date of Peer Review: April 2005

CAS #	7440-43-9	Cd
RTECS #	EU9800000	Atomic mass: 112.4
UN #	2570	
EC #	048-002-00-0	

TYPES OF HAZARD / EXPOSURE	ACUTE HAZARDS / SYMPTOMS	PREVENTION	FIRST AID / FIRE FIGHTING
FIRE	Flammable in powder form and spontaneously combustible in pyrophoric form. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames, NO sparks, and NO smoking. NO contact with heat or acid(s).	Dry sand. Special powder. NO other agents.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE		PREVENT DISPERSION OF DUST! AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
Inhalation	Cough. Sore throat.	Local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
Skin		Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
Eyes	Redness. Pain.	Safety goggles or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion	Abdominal pain. Diarrhoea. Headache. Nausea. Vomiting.	Do not eat, drink, or smoke during work.	Rest. Refer for medical attention.

SPILLAGE DISPOSAL	PACKAGING & LABELLING
Evacuate danger area! Personal protection: chemical protection suit including self-contained breathing apparatus. Remove all ignition sources. Sweep spilled substance into containers. Carefully collect remainder, then remove to safe place.	Airtight. Unbreakable packaging; put breakable packaging into closed unbreakable container. Do not transport with food and feedstuffs. **EU Classification** Symbol: T+, N R: 45-26-48/23/25-62-63-68-50/53 S: 53-45-60-61 Note: [E] **UN Classification** UN Hazard Class: 6.1
EMERGENCY RESPONSE	**STORAGE**
	Fireproof. Dry. Keep under inert gas. Separated from ignition sources, oxidants acids, food and feedstuffs.

IPCS International Programme on Chemical Safety

Prepared in the context of cooperation between the International Programme on Chemical Safety and the Commission of the European Communities © IPCS, CEC 1999

SEE IMPORTANT INFORMATION ON BACK

CADMIUM ICSC: 0020

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
SOFT BLUE-WHITE METAL LUMPS OR GREY POWDER. MALLEABLE. TURNS BRITTLE ON EXPOSURE TO 80°C AND TARNISHES ON EXPOSURE TO MOIST AIR.

PHYSICAL DANGERS:
Dust explosion possible if in powder or granular form, mixed with air.

CHEMICAL DANGERS:
Reacts with acids forming flammable/explosive gas (hydrogen - see ICSC0001.) Dust reacts with oxidants, hydrogen azide, zinc, selenium or tellurium, causing fire and explosion hazard.

OCCUPATIONAL EXPOSURE LIMITS:
TLV: (Total dust) 0.01 mg/m³; (Respirable fraction) 0.002 mg/m³; as TWA; A2 (suspected human carcinogen); BEI issued; (ACGIH 2005).

MAK: skin absorption (H); Carcinogen category: 1; Germ cell mutagen group: 3A; (DFG 2004).

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation of its aerosol and by ingestion.

INHALATION RISK:
A harmful concentration of airborne particles can be reached quickly when dispersed, especially if powdered.

EFFECTS OF SHORT-TERM EXPOSURE:
The fume is irritating to the respiratory tract. Inhalation of fume may cause lung oedema (see Notes). Inhalation of fumes may cause metal fume fever. The effects may be delayed. Medical observation is indicated.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
Lungs may be affected by repeated or prolonged exposure to dust particles. The substance may have effects on the kidneys, resulting in kidney impairment. This substance is carcinogenic to humans.

PHYSICAL PROPERTIES

Boiling point: 765°C
Melting point: 321°C
Density: 8.6 g/cm³
Solubility in water: none

Auto-ignition temperature: (cadmium metal dust) 250°C

ENVIRONMENTAL DATA

NOTES

Reacts violently with fire extinguishing agents such as water, foam, carbon dioxide and halons. Depending on the degree of exposure, periodic medical examination is indicated. The symptoms of lung oedema often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation are therefore essential. Do NOT take working clothes home. Cadmium also exists in a pyrophoric form (EC No. 048-011-00-X), which bears the additional EU labelling symbol F, R phrase 17, and S phrases 7/8 and 43. UN numbers and packing group will vary according to the physical form of the substance.

ADDITIONAL INFORMATION

See Also:
Toxicological Abbreviations
Cadmium (EHC 134, 1992)
Cadmium (WHO Food Additives Series 52)
Cadmium (WHO Food Additives Series 4)
Cadmium (WHO Food Additives Series 24)
Cadmium (WHO Food Additives Series 55)
CADMIUM (JECFA Evaluation)
Cadmium (PIM 069)

IARC evaluation


IPCS INCHEM

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International Agency for Research on Cancer (IARC) - Summaries & Evaluations

Your Query "**Cadmium**" matched 1 documents out of 8835.
1 documents displayed.

0.9996 Cadmium and Cadmium Compounds (IARC Summary & Evaluation, Volume 58, 1993)

09-21-10, http://www.inchem.org/documents/iarc/vol58/mono58-2.html
Summary: In two inhalation studies in rats, malignant lung tumours were produced by cadmium chloride, cadmium sulfide/sulfate, cadmium sulfate and cadmium oxide fume and dust at low levels of exposure for short durations. In one inhalation study in mice of cadmium chloride, cadmium sulfide/sulfate, cadmium sulfate and cadmium oxide fume and dust, some groups exposed to cadmium oxide fume or dust had increased incidences of lung tumours. In one inhalation study in hamsters of cadmium chloride, cadmium ...

Overall evaluation

Cadmium and cadmium compounds are *carcinogenic to humans (Group 1)*.

For definition of the italicized terms, see Preamble Evaluation.

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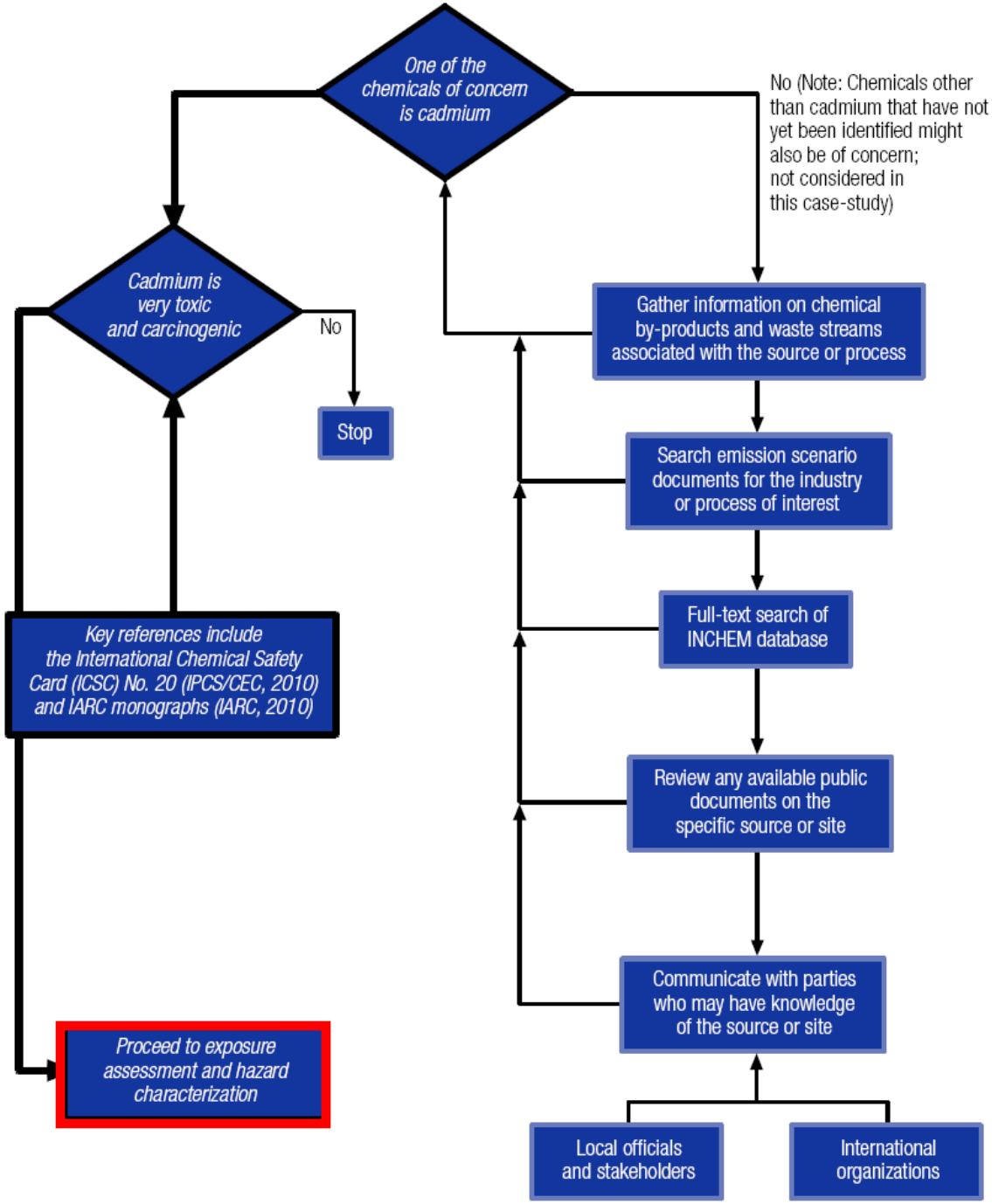
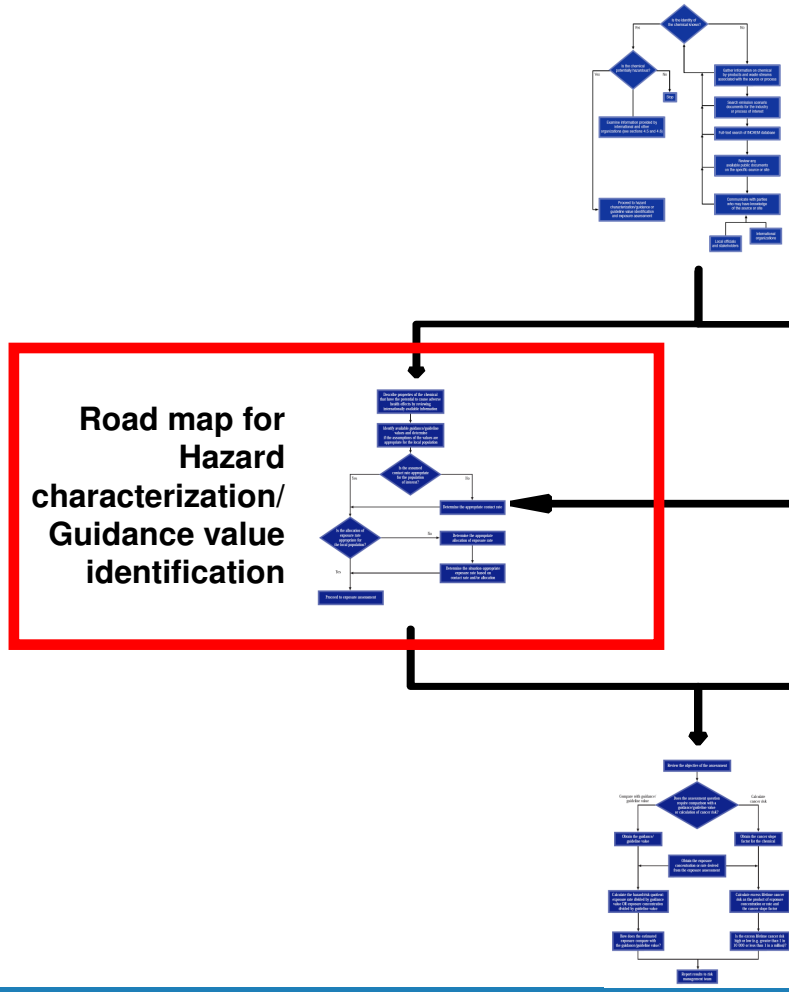
Cadmium case study:

Roadmap for hazard identification



Roadmaps by stage of the risk assessment



Road map for Hazard identification

Road map for Hazard characterization/ Guidance value identification

Road map for Exposure assessment

Road map for Risk characterization

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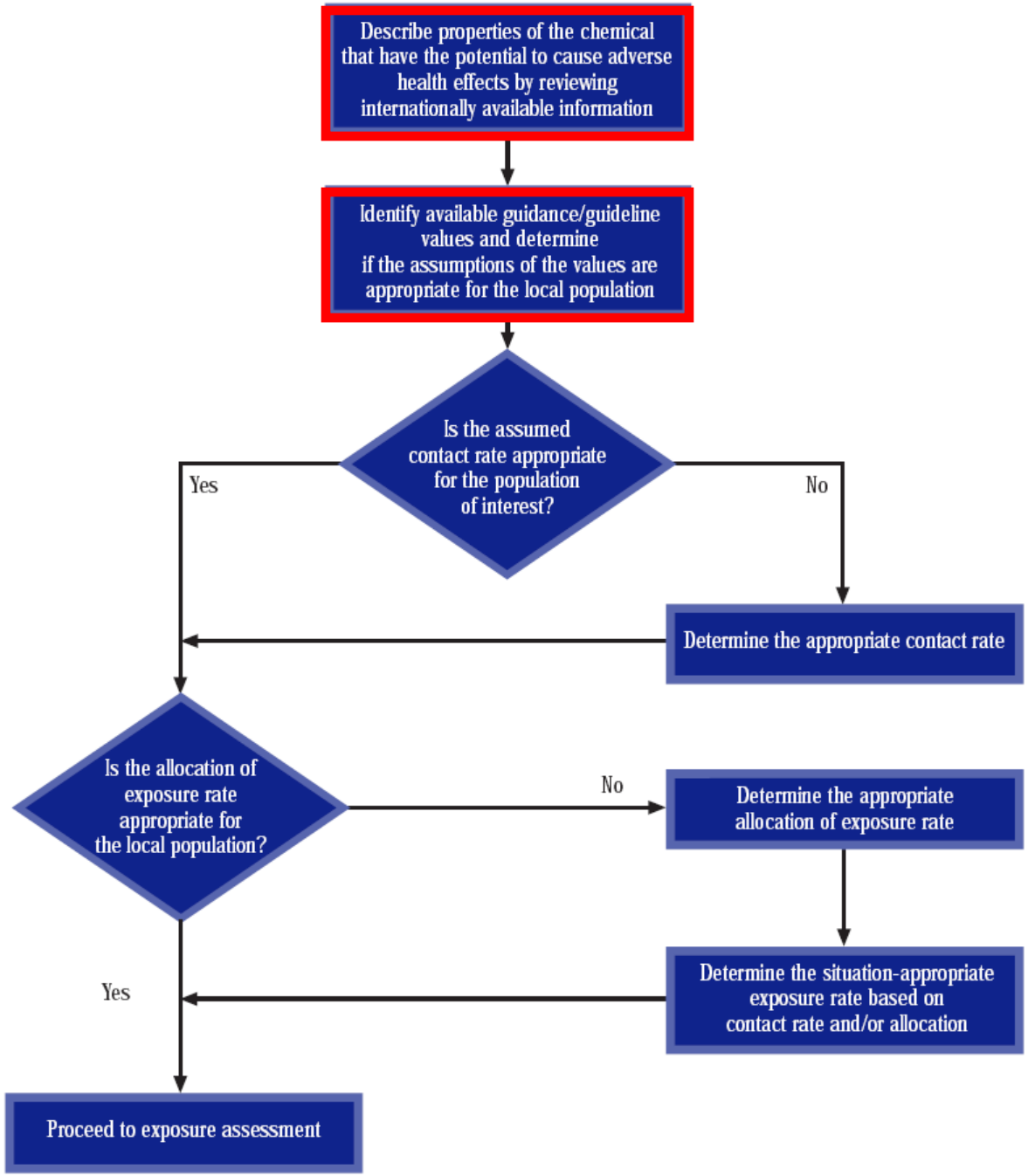
Roadmap for hazard characterization/ guidance and guideline value identification



Key references for Cadmium

1.0000 CONTAMINANTS: CADMIUM (addendum) (JECFA 52, 2004)

09-21-10, http://www.inchem.org/documents/jecfa/jecmono/v52je22.htm
Summary: Nephrotoxicity was induced at lower concentrations of renal cadmium after parenteral exposure to cadmium-metallothionein (Sabolic et al., 2002). In all women, the rate of absorption of cadmium was significantly correlated with age, serum ferritin, serum iron, blood cadmium and urinary cadmium concentrations. In this study, urinary cadmium was considered to be a surrogate for body burden of cadmium, which reflects the overall uptake of cadmium.

1.0000 251. Cadmium (WHO Food Additives Series 4)

09-21-10, http://www.inchem.org/documents/jecfa/jecmono/v004je04.htm
Summary: Likewise, leachable cadmium in enamel and pottery glazes may be a source of cadmium contamination in the food. Since commercial zinc can contain up to 1% cadmium, galvanized food utensils may also contribute to cadmium levels in food. Urinary excretion of cadmium is considerably increased when renal damage has occurred following exposure to excessive amounts of cadmium (Friberg at al., 1971).

1.0000 CADMIUM

09-21-10, http://www.inchem.org/documents/jecfa/jecmono/v46je11.htm
Summary: Metallothionein is also induced by cadmium, and intracellular binding of cadmium to metallothionein protects against the toxicity of cadmium. The blood cadmium concentrations mainly reflected long, light exposure, as the variation in blood cadmium concentration was accounted for by urinary cadmium, serum ferritin, age and fibre intake (Berglund et al. The whole blood and erythrocyte concentrations of cadmium and urinary cadmium excretion were not affected by increased cadmium intake.

1.0000 659. Cadmium (WHO Food Additives Series 24)

09-21-10, http://www.inchem.org/documents/jecfa/jecmono/v024je09.htm
Summary: Major industrial uses of cadmium are in electroplating, pigments, particularly in plastics, plastic stabilizers (e.g., cadmium stearate), and nickel- cadmium rechargeable batteries. Mice given cadmium-metallothionein had lower blood and liver cadmium but higher kidney cadmium concentrations than animals given a similar dose as cadmium chloride (Cherian et al., 1978; Sullivan et al., 1984). The concentration of cadmium in liver and renal cortex may fall subsequent to renal damage and increased...

0.9474 JECFA Evaluations-CADMIUM-

09-21-10, http://www.inchem.org/documents/jecfa/jeceval/jec_297.htm
Summary: CADMIUM Functional class: CONTAMINANT Latest evaluation: 2005 Tolerable

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Evaluations of the Joint FAO/WHO Expert Committee on Food Additives (JECFA)

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Evaluations of the Joint FAO/WHO Expert Committee on Food Additives (JECFA)

CADMIUM

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General Information

CAS number: 7440-43-9

Functional Class:

- Food Contaminant
  - METALS

Evaluations

Evaluation year: **2005**

Comments: The PTWI of 0.007 mg/kg bw that was established at the thirty-third meeting (1988) was not re-evaluated and was maintained at the sixty-fourth meeting (2005). The Committee evaluated the impact of different maximum levels on the overall intake of cadmium and concluded that the effect would be very small. At the proposed Codex maximum levels, mean intake of cadmium would be reduced by approximately 1% of the PTWI. The imposition of maximum levels one level lower would result in potential reductions in intake of cadmium of no more than 6% (wheat, potatoes) of the PTWI. At the proposed Codex maximum levels, no more than 9% of a commodity would be violative (oysters). Maximum levels one level below those proposed would result in approximately [illegible] potatoes, and other vegetables being violative.

Tolerable Intake: PTWI 0.007 mg/kg bw

Meeting: 41

Report: TRS 930-JECFA 64/26

Tox Monograph: FAS 55-JECFA 64/157

Previous Years: 2003, TRS 922-JECFA 61/127, FAS 52-JECFA 61/505. THE PTWI OF 0.007 MG/KG BW THAT WAS ESTABLISHED AT THE THIRTY-THIRD MEETING (1988) WAS MAINTAINED AT THE SIXTY-FIRST MEETING (2003).
2000, TRS 901-JECFA 55/61, FAS 46-JECFA 55/247. THE PTWI OF 0.007 mg/kg

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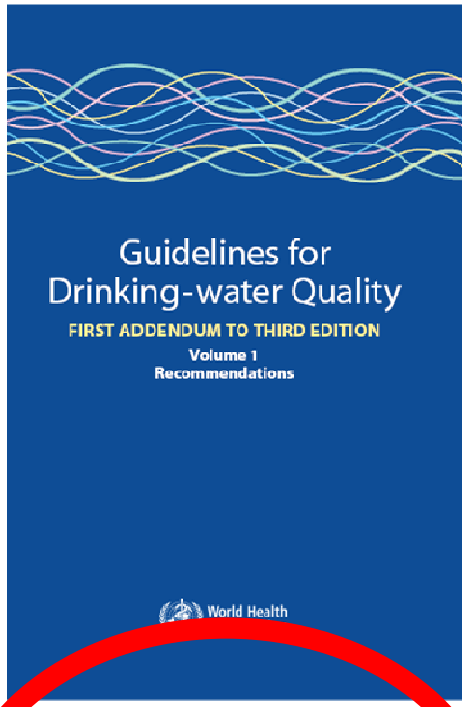
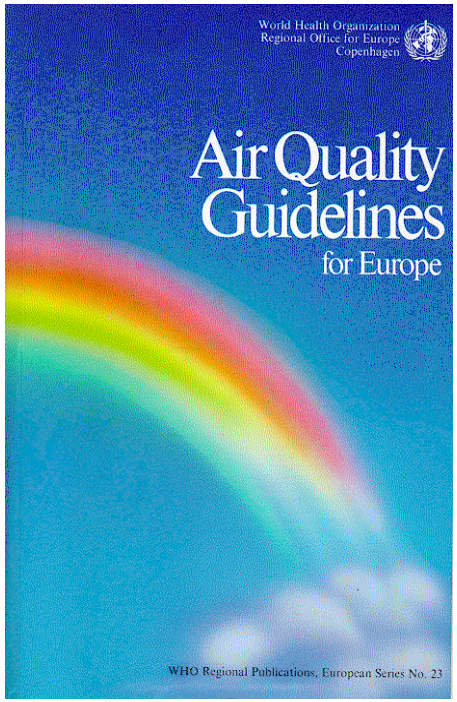
Guideline values for Cadmium



Drinking-water guideline value = 0.003 mg/l



Air quality guideline value not published for Cadmium

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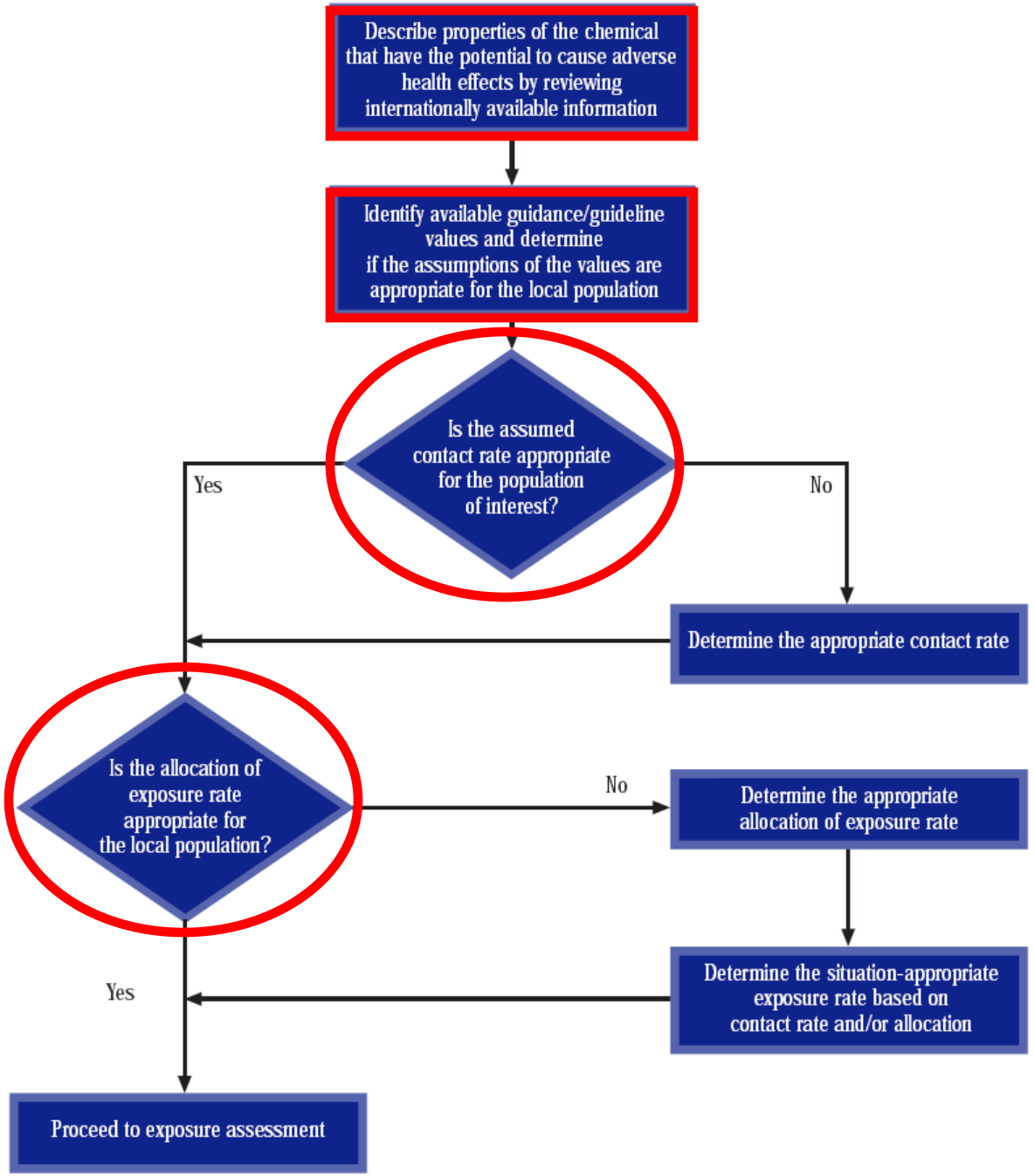
Roadmap for hazard characterization/ guidance and guideline value identification

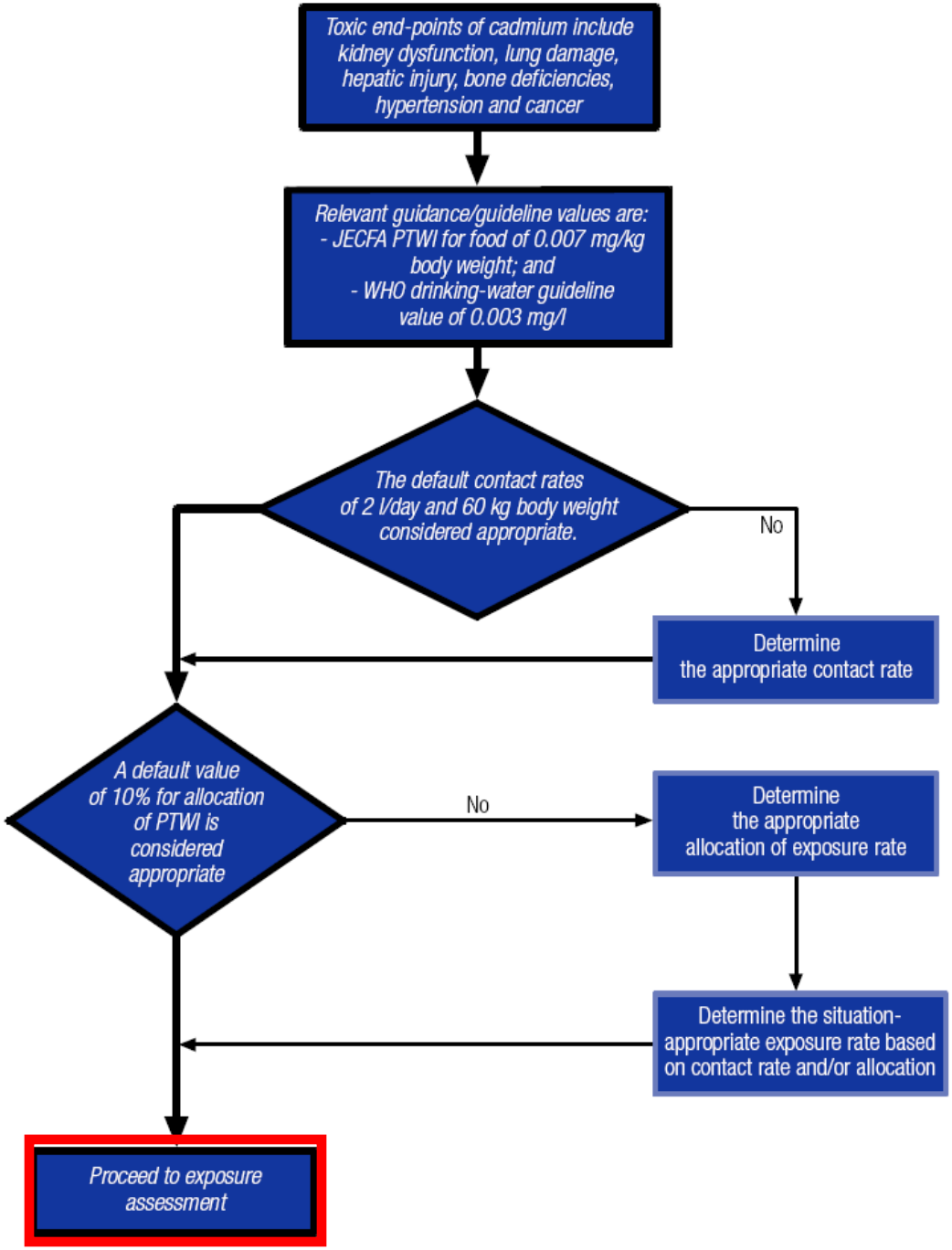


Assumptions embedded in WHO Drinking-water Guideline Value (DWGV) for Cadmium

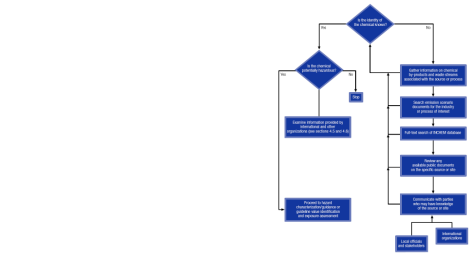
- DWGV Values based on Provisional Acceptable Weekly Intake (PTWI) developed by JECFA.
- PTWI for Cadmium is 0.007 mg/kg body weight.
- 10% of PTWI is allocated to DWGV (0.0007 mg/kg body weight).
- Default water consumption rate is 2 litres per day (14 litres per week).
- Default body weight is 60 kg.
- DWGV = PTWI/10 x 60 kg body weight x 1/14 litres per week
  = 0.003 mg/l

Cadmium case study:

Specific roadmap for hazard characterization/ guidance and guideline value identification



Roadmaps by stage of the risk assessment



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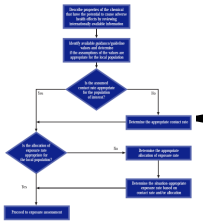
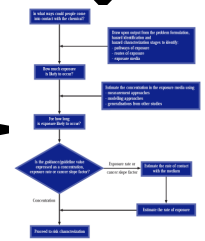
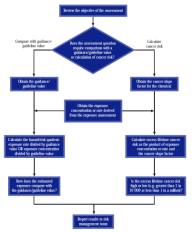




Road map for Exposure assessment



Road map for Risk characterization

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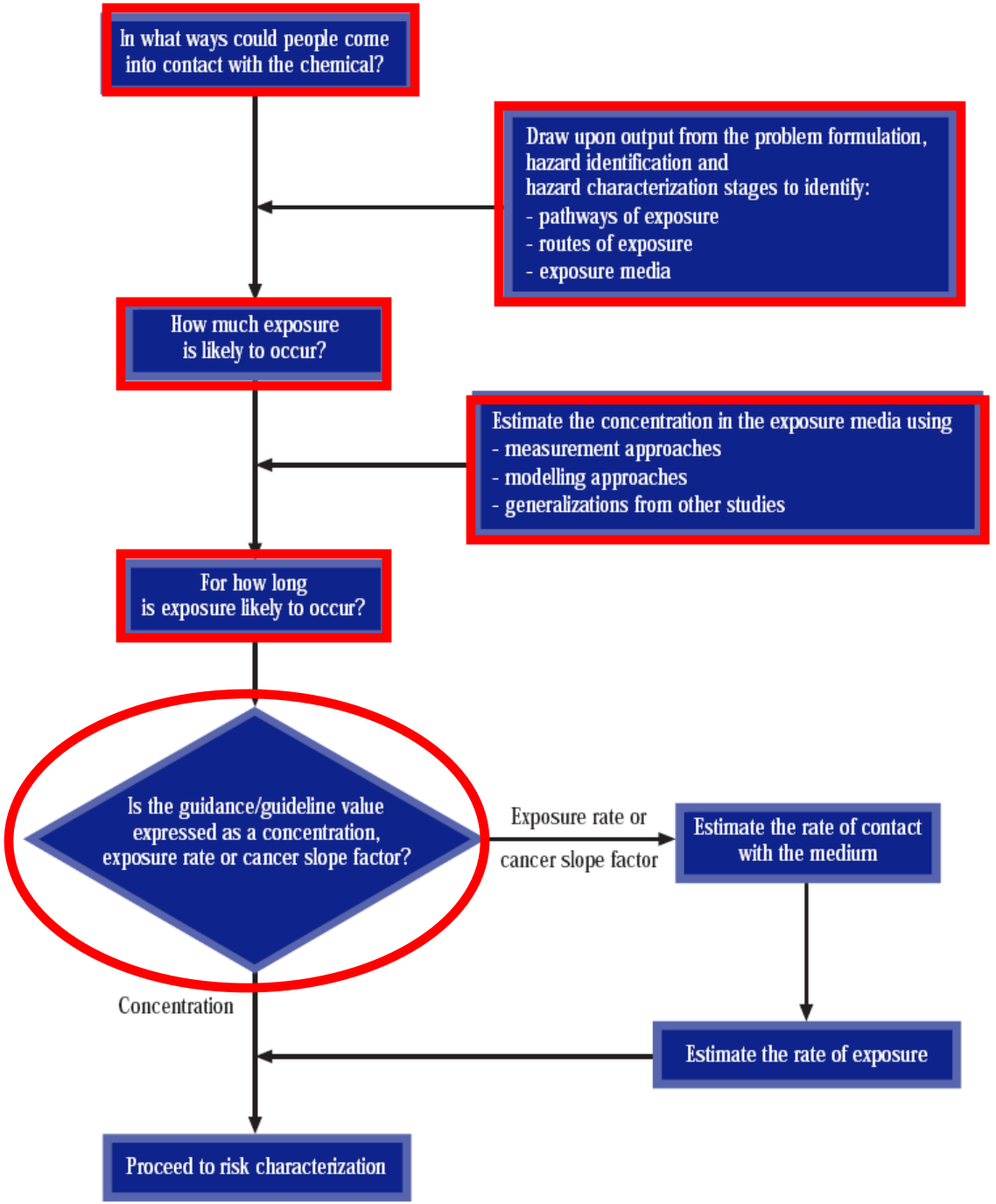
Roadmap for exposure assessment

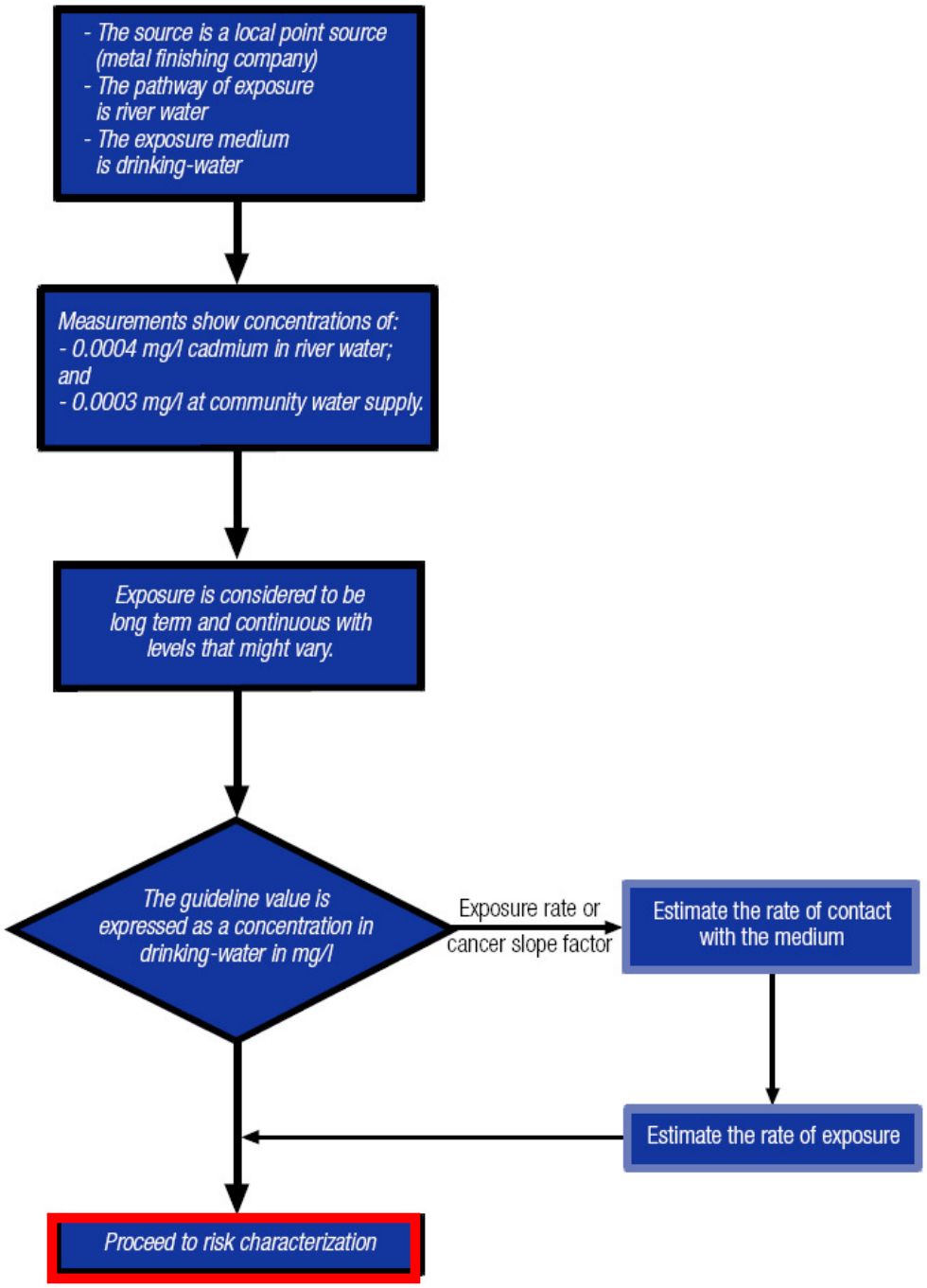


Cadmium concentrations in five samples of water obtained from each of three locations in the vicinity of Rivertown.

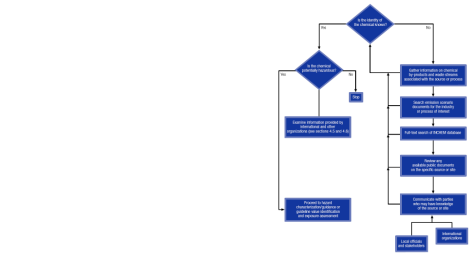
Location	*Average concentration (µg/l)*	*Concentration range (µg/l)*
Upstream of facility	<LOD	<LOD–0.2
Downstream of facility	0.4	0.1–1.0
Town hall water	0.3	0.2–0.8

Case study on cadmium:

Specific roadmap for exposure assessment



Roadmaps by stage of the risk assessment



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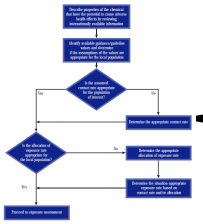
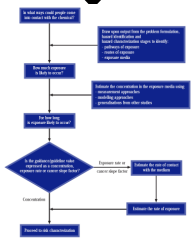
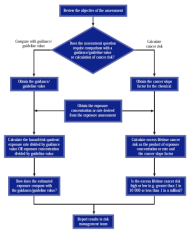




Road map for Exposure assessment



Road map for Risk characterization

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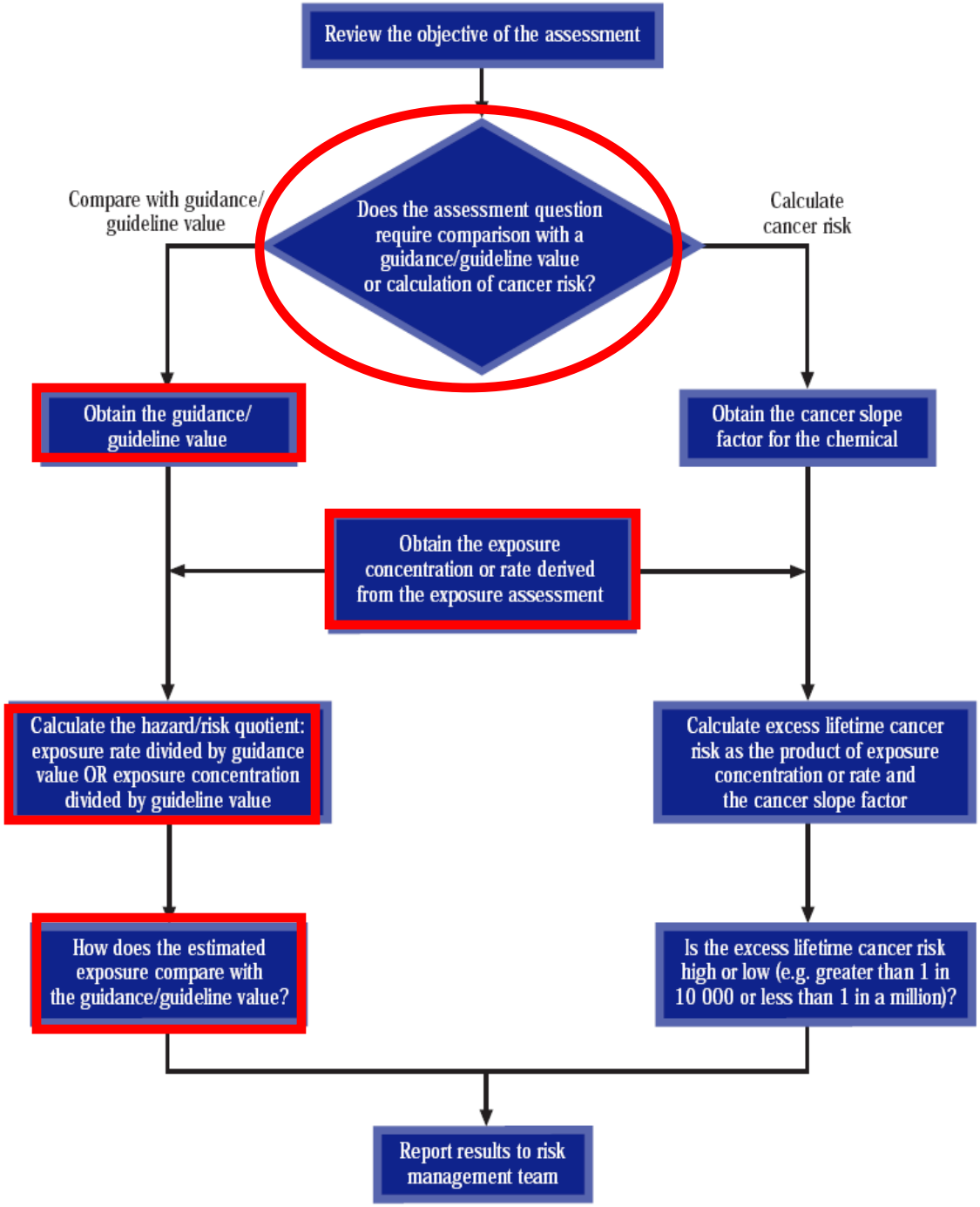
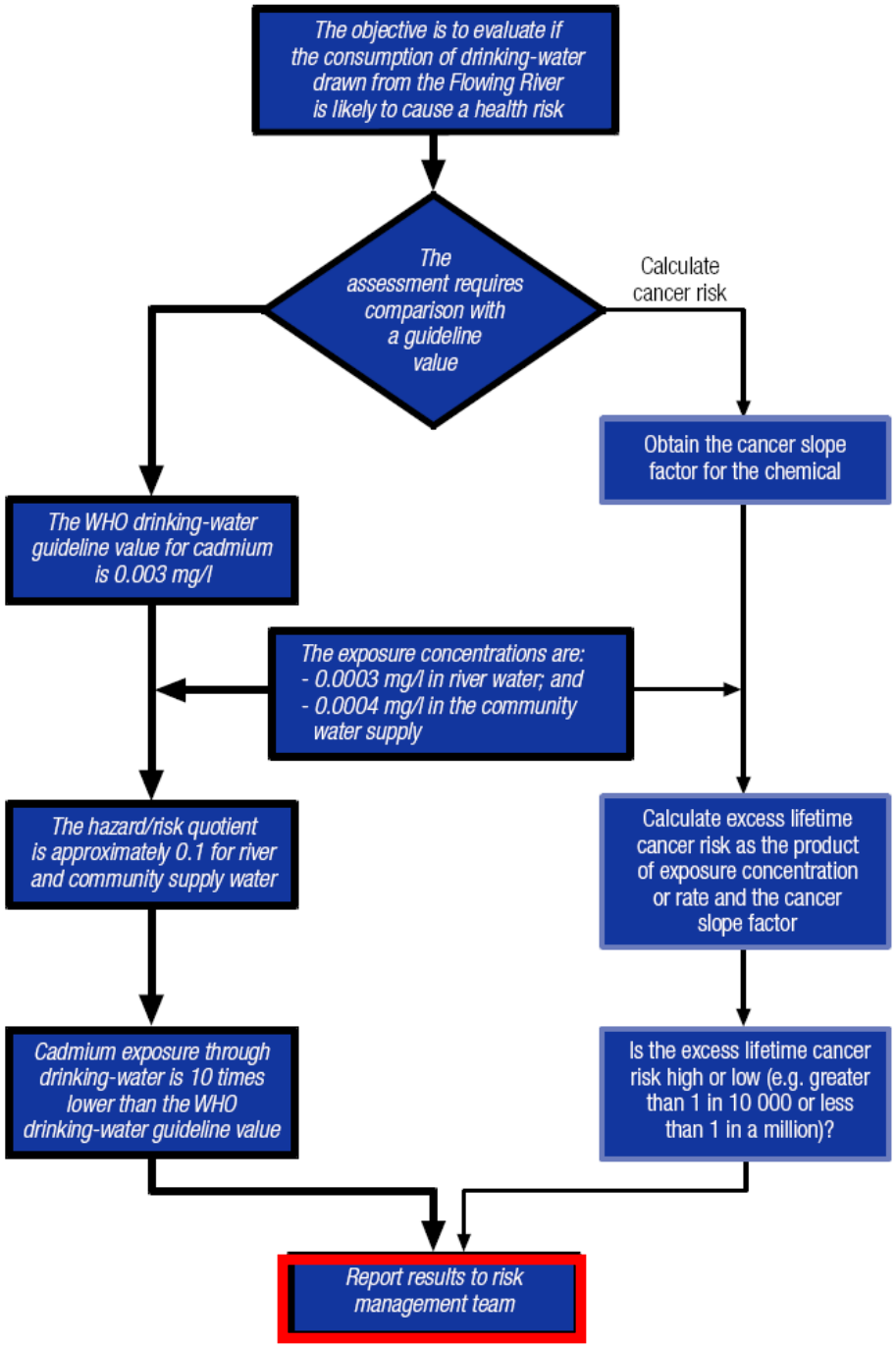
Roadmap for risk characterization



Case study on cadmium:

Specific roadmap for risk characterization



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