Government of Canada / Gouvernement du Canada

Risk Management Scope

for

Thallium and its Compounds

Environment and Climate Change Canada

September 2020

Canada

Summary of Proposed Risk Management

This document outlines the risk management options under consideration for thallium and its compounds (referred to as thallium throughout this document), which have been proposed to be harmful to the environment.

In particular, the Government of Canada is considering reducing anthropogenic releases of thallium to water from the following sectors or activities:

1. **Metal mining:** by reviewing information received from regulated mines in response to environmental effects monitoring requirements under the *Metal and Diamond Mining Effluent Regulations* (MDMER), to determine if additional regulatory or non-regulatory risk management is appropriate.

2. **Base metals smelting and refining:** for facilities that combine their effluent with metal mining operations: through the MDMER, in the same ways as described above for metal mining. For facilities which do not combine effluent with metal mines: by working with industry to gather additional data on thallium concentrations as described below.

3. **Coal-fired power generation:** by implementing the performance standards of the *Reduction of Carbon Dioxide Emissions from Coal-Fired Generation of Electricity Regulations* that came into force in July 2015, which will result in the reduction of thallium emissions from the sector as a co-benefit of the phase-out of traditional coal-fired power plants.

Interested stakeholders are invited to provide the following information to help in refining Environment and Climate Change Canada's (ECCC) risk analysis:

- Metal mining
    - In the receiving environment and reference areas:
        - Dissolved or total concentrations of thallium in surface waters and corresponding measurements of potassium concentrations.
- Base metal smelting and refining
    - In the receiving environment and reference areas:
        - Dissolved or total concentrations of thallium in surface waters and corresponding measurements of potassium concentrations;
    - At the point sources of release:
        - Concentrations of thallium in sediment organisms.

This information should be provided on or before November 14, 2020 to the contact identified in Section 8 of this document.

Under the third phase of the Chemicals Management Plan, ECCC and Health Canada (HC) are conducting assessments on a variety of metals that may identify similar or additional sectors as sources of risk. ECCC is considering the risk management actions for thallium as part of a more comprehensive strategy to manage the metals assessed as toxic under the third phase of CMP. Implementation of this strategy would begin in 2023, when all risk assessments and risk management approaches for these metals will have been completed and published. This strategy is focused on effluents rather than on single metals and will reduce the administrative burden on implicated sectors that would otherwise result from implementing multiple risk management approaches (e.g., repeated amendments to the MDMER).

Note: The above summary is an abridged list of options under consideration to manage thallium and its compounds and to seek information on identified gaps. Refer to section 3 of this document for more details in this regard. It should be noted that the proposed risk management options may evolve through consideration of additional information obtained from the public comment period, literature, and other sources.

Table of Contents

1. Context

The *Canadian Environmental Protection Act, 1999* (CEPA) (Canada, 1999) provides the authority for the Minister of the Environment and the Minister of Health (the ministers) to conduct assessments to determine if substances are toxic to the environment and/or harmful to human health as set out in section 64 of CEPA[1,2], and if so to manage the associated risks.

The ministers have conducted a screening assessment of thallium and its compounds (referred to as thallium throughout this document), including the five substances listed in Annex A (Canada, 2019). These five substances were identified as priorities for assessment as they met categorization criteria under subsection 73(1) of CEPA, were considered a priority on the basis of other ecological concerns (HC, 2017), or were identified for further consideration following prioritization of the Revised In Commerce List (R-ICL)[3] (HC, 2017b). The draft screening assessment focuses on the thallium moiety and therefore considers thallium in its elemental form, thallium-containing substances, and thallium released in dissolved, solid or particulate form.

2. Issue

Environment and Climate Change Canada (ECCC) and Health Canada (HC) conducted a joint scientific assessment to evaluate thallium and its compounds in Canada. A notice summarizing the scientific considerations of the draft screening assessment for these substances was published in the *Canada Gazette*, Part I, on [September 19, 2020]. For further information on the draft screening assessment for thallium and its Compounds, refer to https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/draft-screening-assessment-thallium-compounds.html.

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[1] Section 64 [of CEPA]: *For the purposes of* [Parts 5 and 6 of CEPA]*, except where the expression "inherently toxic" appears, a substance is toxic if it is entering or may enter the environment in a quantity or concentration or under conditions that*

- *(a) have or may have an immediate or long-term harmful effect on the environment or its biological diversity;*
- *(b) constitute or may constitute a danger to the environment on which life depends; or*
- *(c) constitute or may constitute a danger in Canada to human life or health.*

[2] A determination of whether one or more of the criteria of section 64 are met is based upon an assessment of potential risks to the environment and/or to human health associated with exposures in the general environment. For humans, this includes, but is not limited to, exposures from ambient and indoor air, drinking water, foodstuffs, and products used by consumers. A conclusion under CEPA is not relevant to, nor does it preclude, an assessment against the hazard criteria specified in the *Hazard Product Regulations*, which are a part of the regulatory framework for the Workplace Hazardous Materials Information System for products intended for workplace use. Similarly, a conclusion on the basis of the criteria contained in section 64 of CEPA does not preclude actions being taken under other sections of CEPA or other Acts.

[3] The Revised In Commerce List (R-ICL) is a list of substances that are known to have been authorized for use in commerce in Canada between 1987 and 2001. As the substances are present in Canada, the government is addressing them for potential impact on human health and the environment, in order to risk-manage the substances if required.

2.1 Draft Screening Assessment Conclusion

On the basis of the information available, the draft screening assessment proposes that thallium and its compounds are toxic under section 64*(a)* of CEPA because they are or may be entering the environment in a quantity or concentration or under conditions that have or may have an immediate or long-term harmful effect on the environment or its biological diversity.

The draft screening assessment also proposes that thallium and its compounds meet the criteria for persistence as defined in the *Persistence and Bioaccumulation Regulations* made under CEPA (Canada, 2000). The weight of evidence indicates that thallium is easily assimilated by various organisms and has the potential to accumulate in both aquatic and terrestrial organisms. However, no conclusion can be reached on the potential of thallium biomagnification in both aquatic and terrestrial food chains considering the limited and contradictory data currenly available.

The risks of concern, identified in the draft screening assessment, are based on the release of thallium from metal mining, some base metals smelters and refineries, and from coal-fired power plants. As such, this document will focus on these activities and exposure sources of concern (refer to section 5.2).

2.2 Proposed Recommendation under CEPA

On the basis of the findings of the draft screening assessment, the Ministers propose to recommend that thallium and its compounds be added to the List of Toxic Substances in Schedule 1 of the Act[4].

The Ministers will take into consideration comments made by stakeholders during the 60-day public comment period on the draft screening assessment and Risk Management Scope document. If the Ministers finalize the recommendation to add thallium and its compounds to Schedule 1, a risk management instrument must be proposed and finalized within a set period of time, as outlined in sections 91 and 92 of CEPA (refer to section 8 for publication timelines applicable to this group of substances).

3. Proposed Risk Management

[4] When a substance is found to meet one or more of the criteria under section 64 of CEPA, the Ministers can propose to take no further action with respect to the substances, add the substance to the Priority Substances List for further assessment, or recommend the addition of the substance to the List of Toxic Substances in Schedule 1 of the Act.

3.1 Proposed Environmental Objective

Proposed environmental objectives are quantitative or qualitative statements of what should be achieved to address environmental concerns.

For this substance grouping, the proposed objective is focused on addressing the exposure sources of concern from the sectors outlined in section 5 of this document. As such, the proposed environmental objective for thallium is to reduce anthropogenic releases of thallium to fresh- or marine waters so as not to exceed levels that cause long-term adverse effects to aquatic and terrestrial organisms.

3.2 Proposed Risk Management Objective

Proposed risk management objectives set quantitative or qualitative targets to be achieved by the implementation of risk management regulations, instrument(s) and/or tool(s) for a given substance or substances.

In this case, the proposed risk management objective for thallium is to achieve the lowest level of releases of thallium to water that is technically and economically feasible, taking into consideration socio-economic factors and natural background concentrations.

Such objectives will be refined on the basis of consultation with stakeholders, the proposed risk management options, consideration of further information received, the outcome of the final screening assessment, and socio-economic and technical considerations (such as may be outlined in section 6 of this document).

Revised environmental and risk management objectives should next be presented in the Risk Management Approach document that will be published concurrently with the final screening assessment for these substances, or in subsequent risk management documents (e.g., consultation document on proposed instrument), as the case may be.

3.3 Proposed Risk Management Options under Consideration

To achieve the proposed risk management objective and to work towards achieving the proposed environmental objective, the risk management options under consideration for thallium will focus on reducing releases of thallium to water from the sectors of concern identified in the draft screening assessment – metal mining, base metals smelting and refining facilities, and coal-fired power plants. The proposed actions are described below.

Note that the proposed risk management options, described in this document, are preliminary and subject to change. Following the publication of this document and publication of other metal assessments, additional information obtained from the

public comment period and from other sources will be considered, along with the information presented in this document, in further instrument selection and development processes[5], if required. The risk management options outlined in this document may also evolve through consideration of assessments and risk management options published for other CMP substances to ensure effective, coordinated, and consistent risk management decision-making.

3.3.1 Metal mining

The existing risk management instrument for thallium in effluents discharged from the metal mining sector is the *Metal and Diamond Mining Effluent Regulations* (MDMER) under the *Fisheries Act* (Canada, 2018a).

The MDMER prescribes environmental effects monitoring, including effluent characterization for a list of substances for any metal or diamond producing mines, as defined in section 2 of the MDMER, that on or after June 6, 2002 exceed an effluent flow rate of 50 m^3 per day. Thallium was added to the list of monitoring substances (Schedule 5 of MDMER) in an amendment that came into effect in June, 2018. (Canada, 2018b).

Under the third phase of the CMP, ECCC and HC are conducting assessments on a variety of metals that may also identify metal mines as sources of risk. Following publication of these metal assessments, ECCC will review the information received from regulated mines in response to environmental effects monitoring requirements under MDMER to determine if additional regulatory or non-regulatory risk management of effluents from metal mines is appropriate for one or more assessed metals.

ECCC is considering the risk management (RM) actions for thallium as part of a more comprehensive strategy to manage the metals assessed as toxic under the third phase of CMP. Implementation would begin in 2023, when all risk assessments and risk management approaches for these metals will have been completed and published. This risk management is focused on managing all CEPA toxic metals in effluents from metal mines, rather than managing single metals. This strategy will reduce the administrative burden on implicated sectors that would otherwise result from implementing multiple risk management approaches (e.g., repeated amendments to the MDMER) over a five year period, for metals assessed and found to be toxic.

[5] The proposed risk management regulation(s), instrument(s) or tool(s) will be selected using a thorough, consistent and efficient approach and take into consideration available information in line with the Government of Canada's Cabinet Directive on Regulatory Management (TBS, 2012a), the Red Tape Reduction Action Plan (TBS, 2012b), and in the case of a regulation the *Red Tape Reduction Act* (Canada, 2015).

3.3.2 Base metals smelting and refining

Base metals smelting and refining facilities vary significantly in terms of their feedstocks, processes and products, and are therefore expected to have varying levels of thallium in their effluent, ranging from insignificant to high enough to be a source of concern.

The MDMER apply to 5 out of 11 existing smelters and refineries which combine their effluent with that of a metal mine effluent. For these facilities, ECCC would proceed in the same way as described for metal mining. For the remaining six facilities that do not combine their effluent with metal mines, ECCC is proposing to work with these facilities to gather additional data on their effluent thallium concentrations, as well as concentrations in the receiving environment(s) and reference area(s) for surface waters and in sediment organisms at the point sources of release. This will allow ECCC to determine what risk management measures should be developed, if any, for these facilities.

3.3.3 Coal-fired power plants

The volatilization of thallium from coal burning at high temperatures and subsequent re-condensation on finer ash particles results in high thallium concentrations on ash particles. The deposition of these fly ashes and effluent released from ash lagoons from the power generation sector has the potential to release thallium into the environment.

Other federal actions to address the sector will provide a co-benefit for reducing thallium releases. The Government of Canada published the *Reduction of Carbon Dioxide Emissions from Coal-Fired Generation of Electricity Regulations* in September 2012 (Canada, 2012). The regulations set a stringent performance standard for new coal-fired electricity generation units and those that have reached the end of their useful life. The implementation will cause a permanent shift to lower- or non-emitting types of electricity power generation. By phasing out traditional coal-fired electricity units, the regulation will also reduce the potential risk for thallium releases associated with coal-fired electricity generation over time. The performance standard requirements under the regulations came into effect on July 1, 2015. Furthermore, as announced in November 2016, the federal government intends to accelerate this phase out of traditional coal-firing by amending these regulations to attain phase out by 2030; this will further reduce the potential risk for thallium over time.

3.4 Risk Management Information Gaps

Interested stakeholders are invited to provide further information, as outlined below, to help in refining ECCC's proposed risk management:

- Metal mining

    - In the receiving environment and reference areas:
        - Dissolved or total concentrations of thallium in surface waters and corresponding measurements of potassium concentrations.
- Base metal smelting and refining
    - In the receiving environment and reference areas:
        - Dissolved or total concentrations of thallium in surface waters and corresponding measurements of potassium concentrations;
    - At the point sources or release:
        - Concentrations of thallium in sediment organisms.

Stakeholders are requested to provide further information to help address these gaps on or before November 14, 2020 to the contact identified in section 8 of this document.

4. Background

4.1 General Information on thallium and its compounds

Thallium exists in the earth's crust at the level of 0.7 mg/kg (USGS, 2018). It is typically associated with sulfide ores of various metals including zinc, copper, iron, lead, and in coal (Kazantzis, 1979). Certain minerals such as crookesite ($(Cu,Tl,Ag)_2Se$), lorandite ($TlAsS_2$), hutchinsonite ($(Tl,Pb)_2As_5S_9$) and avicennite (Tl_2O_3) contain thallium up to 60% (Reimann & de Caritat, 1998), but these minerals are rare. Thallium is also present in meteorites, volcanic rocks, plants, and trace amounts in most living organisms, although it is not an essential element.

4.2 Current Uses and Identified Sectors

Thallium substances are used in a variety of sectors, including: the semiconductor and laser industries, fiber (optical) glasses, photoelectric cells, high temperature superconductors, as an activator in gamma radiation detection equipment (scintillometer), and as intermediates in chemical production. Thallium is also used in low temperature thermometers, mercury arc lamps, alloys with other metals, jewellery, fireworks, pigments and dyes, for mineralogical separation, and the impregnation of wood and leather against fungi and bacteria. In addition, the radioactive isotope thallium-201 is used in imaging of the heart to determine the location and extent of coronary artery blockages, and scar tissue from previous heart attacks (Blumenthal et al. 2013). Thallium's use in bactericides, rodenticides, and insecticides has been banned in most countries due to its high toxicity, accumulation in body tissues and persistence in the environment. In Canada, thallium sulfate based insecticides for ants were the

only registered agricultural use for thallium and this use was discontinued in 1974 (CCME, 1999a).

Additional uses of thallium in Canada are in products available to consumers: as a radiopharmaceutical in human drug products (HC, 2018), (HC, 2016) and as a medicinal ingredient in homeopathic licensed natural health products (HC, 2019). Thallium may also be used in Canada as a component in food packaging materials.

Anthropogenic sources of thallium are primarily associated with incidental releases of residues/by-products from various industrial activities, such as the smelting/refining process, metal mining, or fly ashes of coal-fired electrical power plants. Thallium production is low with less than 9 tonnes produced globally in 2017 (USGS, 2018).

4.2.1 Metal mining

Thallium is not produced in Canada. However, it is often recovered from sulphide ores of lead, copper and zinc and may also be associated with cadmium, iron and potassium minerals such as feldspars and micas (CCME, 1999b).

The processing of ore during extraction and concentration generates dust that may escape and be deposited nearby, and produces effluent which may be stored in tailings ponds or treated and released to surface water. The generated dusts, potential leachates from tailings ponds, and effluent releases to surface water are all pathways from which thallium may be released into the surrounding environment.

Mines and mills, even if they do not produce thallium, may release thallium to the environment, since this metal is present in a variety of ores.

4.2.2 Base metals smelting and refining

Thallium is recovered commercially as a by-product from cadmium refineries and copper, zinc and lead smelters (CCME, 1999a). Base metals smelting and refining facilities produce one or more metals, such as copper, lead, nickel, zinc and cobalt, from feed material that primarily comes from ores. They also produce intermediate and compound products and other saleable metals, such as precious metals.

The smelting process uses heat and chemical reduction to extract the metal from mined ores. Traces of thallium are found in many mined ores, but primarily ores with zinc, copper or lead deposits (CCME, 1999a). Thallium may be found in intermediate products, residues or main products from the smelting or refining process.

4.2.3 Coal-fired electrical power generation

Thallium is found as a trace element in coal, particularly in sulphide-rich coal deposits. The combustion of coal at coal-fired electrical power generation plants results in thallium being concentrated in the fly-ash.

5. Exposure Sources and Identified Risk

5.1 Natural Sources

Natural releases of thallium to the aquatic environment occur primarily by the weathering of minerals and rocks that contain thallium (CCME, 1999a). Soil erosion, forest fires, and volcanic activity can also contribute to thallium entering the aquatic environment naturally.

Naturally occurring background levels of thallium were identified in the draft screening assessment and were taken into consideration when estimating the exposure of ecological receptors to thallium-containing substances.

5.2 Anthropogenic Releases to the Environment

Since 2014, Canadian facilities must annually report releases, disposals and transfers for recycling of thallium (and its compounds) to the National Pollutant Release Inventory (NPRI) if they meet specific requirements.

Anthropogenic releases of thallium to the environment have been identified in the draft screening assessment as posing a risk in some sectors, which are identified below.

5.2.1 Metal mining

In 2017, 31 metal ore mining facilities in Canada reported releases, disposal and/or off-site recycling of thallium and its compounds to the National Pollutant Release Inventory (ECCC, 2017). These facilities reported on-site releases of 161 kg to air, 31 kg to water and 16 kg to land, while on-site disposal amounted to 132 153 kg and off-site disposal was 115 kg (ECCC, 2017). It should be noted that “disposal” includes information on the disposal of tailings and waste rock, which tend to be disposed of on-site.

Thallium was not required to be reported as part of effluent characterization under MDMER prior to amendments that came into effect in 2018. However, data presented in the draft screening assessmentincludes information that was extracted from voluntary reports of thallium effluent releases to the receiving surface water from 39 metal mining facilities between 2013-2017 as part of the

Environmental Effects Monitoring (EEM) program (EEM 2018) which indicates that thallium releases from this sector are likely the cause of the elevated thallium levels found near some of the exposure sites compared to reference sites.

For this sector, thallium concentrations in some receiving surface waters near sources of releases may exceed the predicted no-effect concentration ($PNEC_{freshwater}$) for aquatic organisms.

In the metal mining sector in Canada, information on thallium concentrations in receiving surface waters or in effluents is limited as data are only available for approximately one third of the facilities. In the near future, once extensive high quality environmental monitoring data for thallium are available for the sector, further data analysis can be performed for better understanding of the potential impacts of this industrial sector.

5.2.2 Base metals smelting and refining

In 2017, 3 base metals smelters and refineries reported thallium and its compounds to the NPRI (ECCC, 2017). These facilities reported on-site releases of 277 kg to air, 1447 kg to water and 0 to land, while on-site disposal amounted to 119 kg, off-site disposal was 79 476 kg and off-site recycling was 0 (ECCC, 2017).

The risk characterization focusing on thallium in the base metals smelting sector was limited to six of eleven facilities, where exposure data were available for surface freshwater and marine water. While the focus of risk management will be the release of thallium to water, the draft screening assessment also identifies the release of thallium to air from the base metals smelting and refining sector as a potential contributor to thallium levels in environmental media.

Releases varied significantly among facilities, as expected, due to their different processes and products. Modelled and measured data in water in exposure areas of some of the facilities indicate that effluents from this industrial activity contribute to a potential risk for thallium exposure.

5.2.3 Coal-fired power plants

In 2017, 5 facilities reported 31 kg thallium and its compounds released to air in the NPRI by the electric power generation sector. For disposal, 841 kg were reported to be disposed on-site and 703 kg were disposed off-site (ECCC, 2017). However, the deposition of fly ashes and effluent released from ash lagoons from the power generation sector has the potential to release thallium into the environment. Estimated thallium concentrations downstream from an ash lagoon discharged at one facility were found to represent a risk to water.

To note, the exposure data in ash lagoons for coal-fired power generation plants were dated pre-2006, so may not reflect current exposure levels. A higher percentage of particulates (including thallium) recovered from flue dusts ending up in ash lagoons may ultimately result in lower thallium concentrations discharged into surface water with the implementation of Canada-wide Standards for Mercury Emissions from Coal-fired Power Stations (CCME 2006).

5.2.4 Publicly Owned Wastewater Treatment Systems (WWTS)

Low quantities of thallium reported to NPRI from this sector, as well as thallium monitoring conducted for 25 WWTS facilities across Canada suggested thallium releases to water or input from bio-solids in agricultural land from this sector are insignificant and do not constitute a risk.

6. Risk Management Considerations

6.1 Alternatives and Alternate Technologies

For sectors of concern identified in the draft screening assessment, it is not expected that chemical alternatives or alternate process technologies would be a practical approach to minimizing releases of thallium.

Additional effluent control technologies (e.g., additional on-site or off-site effluent treatment), process optimization, and recovery of waste metals at the end of the process may be effective approaches for most sectors, as appropriate and economically feasible.

6.2 Socio-economic and Technical Considerations

Socio-economic factors will be considered in the selection process for a regulation or instrument respecting preventive or control actions, and in the development of the risk management objective(s). Socio-economic factors will also be considered in the development of regulations, instrument(s) or tool(s) as identified in the *Cabinet Directive on Regulatory Management* (TBS, 2012a) and the guidance provided in the Treasury Board document *Assessing, Selecting, and Implementing Instruments for Government Action* (TBS, 2007).

7. Overview of Existing Risk Management

7.1 Related Canadian Risk Management Context

7.1.1 Metals Mines

The existing risk management instrument for thallium in effluent discharged from the metal mining sector is the *Metal and Diamond Mining Effluent Regulations* (MDMER) under the *Fisheries Act* (Canada, 2018a).

The MDMER authorizes the deposit of certain deleterious substances into waters frequented by fish within regulated limits. Thallium is not listed in Schedule 4 (prescribed effluent limits for certain deleterious substances). However, as part of amendments to the MDMER that came into force on June 1, 2018, thallium is listed in Schedule 5 and is measured as part of the effluent characterization and water quality monitoring for the MDMER environmental effects monitoring program.

For complete details on the MDMER refer to:

https://laws-lois.justice.gc.ca/eng/regulations/sor-2002-222/FullText.html

In 2009, Environment Canada published the *Environmental Code of Practice for Metal Mines*, made pursuant to subsection 54(4) of CEPA, to support the MDMER and to include other subjects that are not dealt with in the MDMER, which may have an influence on the environmental impact of mining operations. The objective of the Code is to identify and promote recommended best practices to facilitate and encourage continual improvement in the environmental performance of mining facilities throughout the mine life cycle (ECCC, 2009).

Provinces and territories may have established effluent limits for metal mines, either by regulations, permits, licenses, or certificates of approval. The limits are generally the same as those in the MDMER, but may be more stringent to address site-specific or jurisdiction-specific circumstances.

7.1.2 Base Metal Smelting and Refining

Atmospheric emissions from smelters and refineries were assessed under the Priority Substances List and concluded to be toxic under CEPA (ECCC + HC, 2001).

Base metals smelting and refining facilities were subject to a Pollution Prevention Planning Notice published in 2006 and was fully implemented in December 2018. The Notice included 2008 and 2015 annual release targets for particulate matter, which contains most of the metals emitted to air, including thallium. The Notice required facilities to take into consideration a number of factors including the

Environmental Code of Practice for Base Metals Smelters and Refineries, which recommends particulate matter emission limits to air and effluent limits for chemical parameters and certain metals (ECCC, 2006).

The base metals smelting and refining facilities subject to the notice reduced particulate matter releases by a total of 50% between 2005 and 2015.

As a result of the implementation of the Base-Level Industrial Emission Requirements (BLIERs) through performance agreements, it is expected that particulate matter emissions will be further reduced from that of 2015 levels. Since most metals from these facilities are discharged to the atmosphere as particulate matter emissions, it is anticipated that emissions of metals, including thallium, would also be reduced as a co-benefit of particulate matter emission reductions. While thallium is not specifically monitored in the emissions or in the environment as part of the BLIERs program, it is expected that thallium reductions will be reflected in the annual emissions data reported by smelters and refineries to the National Pollutant Release Inventory (NPRI).

7.1.3 Coal-fired electrical power generation

In January 2003, Environment Canada released the *New Source Emission Guidelines for Thermal Electricity Generation* under CEPA. These guidelines provide limits for emissions of sulfur dioxide (SO_2), nitrogen oxides (NO_x) and particulate matter (PM) from new fossil-fuel fired steam-cycle combustion units (ECCC, 2003).

On October 11, 2006, the CCME endorsed *Canada-wide Standards for Mercury Emissions* to significantly reduce mercury emissions from the coal-fired electric power generation sector. The 2012 progress report describes an increasing mercury capture rate, from 28 to 56% since the 2003 baseline year, and a resulting total reduction of mercury emissions of nearly 70%. Reductions in thallium emissions, as co-benefits, are expected, but will depend on the nature of the technology chosen to reduce mercury emissions. For instance, the installation of activated carbon injection and a fabric filter is expected to reduce emissions of other metals, organics, and particulate matter. Thallium emissions have not been documented in the progress report (CCME, 2014).

The *Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations,* which came into force in 2015, will set a stringent performance standard for new coal-fired electricity generation units and those that have reached the end of their useful life (Canada, 2012). The regulations are expected to generate co-benefits for the releases of metals, including thallium, to varying degrees depending on the actions taken by the facilities (e.g., closure, installation of carbon capture and storage technologies, or transition to low-emission fuels). Furthermore, as announced in November 2016, the federal government intends to accelerate this phase out of traditional coal-firing by

amending these regulations to attain phase out by 2030; this will further reduce the potential risk for thallium over time.

7.1.4 Other national actions

The Canadian Council of Ministers of the Environment (CCME) has a recommended Canadian Water Quality Guideline (CWQG) for protection of aquatic life for thallium of 0.8 µg/L (CCME, 2008) and a Canadian Soil Quality Guideline of 1 mg/kg. These non-regulatory guidelines often set the basis on which many Canadian provincial, territorial, and municipal regulations, guidelines and standards are formed, though further research and data is required if new parameters are to be implemented instead.

On July 12, 2014, Environment Canada added thallium and its compounds to the National Pollutant Release Inventory (NPRI) Substance List at an alternate reporting threshold of 100 kg manufactured, processed or otherwise used (MPO), as well as a concentration threshold of 1%. This is due to the fact that thallium is mainly a by-product released by industries, such as metal mines and smelters, coal-fired power plants, and cement manufacturers using coal as fuel. With its addition, it will encourage industries to take voluntary action while tracking the progress in reducing thallium releases, improve public understanding and identify priorities for action (ECCC, 2015c; ECCC, 2015d; ECCC, 2015d) .

7.1.5 Provincial and territorial

The CWQG provides the standard thallium limit guidelines in the following provinces: British Columbia, Alberta, Saskatchewan, Manitoba, and New Brunswick (Government of Alberta: Environment and Parks, 2014; Saskatchewan Environment, 2006; Government of Manitoba, 2011; Government of British Columbia, 2015; ECCC, 2015a; Saskatchewan Environment, 2006; Government of Manitoba, 2011; Government of British Columbia, 2015; ECCC, 2015a). However, no provincial or territorial guidelines for thallium could be found for Québec, Newfoundland and Labrador, Prince Edward Island, the Northwest Territories, Nunavut, and the Yukon Territory (Développement durable, Environnement, Faune et Parcs, 2013).

British Columbia refers to the 2007 version of the CCME CWQG to form both Water Quality Guidelines and Working Water Quality Guidelines for freshwater aquatic life at 0.8 µg/L, though the working water quality objective is site-specific to the lower Columbia River based on a 30-day average concentration (ECCC, 2015a) , (BC MoECCS, 2017). The concentration dictates the level that should not be exceeded by the average value from 5 or more samples collected at similar time intervals within the 30-day frame. The ambient water quality objective for the river is likely to protect designated wildlife, aquatic life, livestock, irrigation and primary-contact recreation (BC MoECCS, 2000).

Ontario's *Interim Provincial Water Quality Objectives* (IPWQO) provides a protection value for thallium to be 0.3 /µg/L to ensure that the ambient surface water quality is acceptable for aquatic life and recreation (MoEE, 1994). This value may change as there is insufficient toxicological information to provide an actual Provincial Water Quality Objective.

Nova Scotia does not have any water quality guidelines for thallium or thallium-containing substances; even so the province recognizes thallium as a potential substance of concern. Therefore, to abide *Contaminated Sites Regulations*, the fresh water pathway specific standard for surface water is 0.8 /µg/L in specific contaminated sites (Nova Scotia Environment, 2014).

7.2 International Risk Management Context

7.2.1 United States – Statutes

There are a number of thallium compounds that appear on various United States (U.S.) environmental statute lists. Described below are the US Statutes that designate compounds as hazardous.

The *Federal Water Pollution Control Act*, also known as the *Clean Water Act* (CWA), promotes the national goals and policies to protect, reduce and eliminate pollutants by setting the surface water quality standards as well as the discharge and/or regulations for pollutants in waters in order to maintain and re-establish its biology, chemistry, and physicality. Section 311(b)(2)(A) of CWA requires the U.S. Environmental Protection Agency (EPA) to compile a list of hazardous substances which, when discharged to navigable waters of adjoining shorelines, present an imminent and substantial danger to the public health or welfare. This includes danger to fish, shellfish, wildlife and beaches. Thallium (I) sulfate (CAS numbers 7446-18-6 and 10031-59-1) is on the CWA List of Hazardous Substances (US EPA, 2019).

Title III of the *Superfund Amendments and Reauthorization Act* of 1986 (SARA), also known as the *Emergency Planning and Community Right-to-Know Act* of 1986 (EPCRA), establishes a program designed to encourage state and local planning and preparedness for spills and releases of extremely hazardous substances (EHS). Under Section 302 of SARA, EPA developed a list of extremely hazardous substances and established threshold planning quantities (TPQs) for each of these substances. Facilities that have present an EHS in excess of its TPQ must notify its state emergency response commission and participate, as necessary, with the local emergency planning committee in the local emergency planning process. Thallium(I) carbonate (CAS 6533-73-9), thallium(I) chloride (CAS 771-12-0) and thallium(I) sulfate (CAS 7446-18-6) are on the EHS list.

Under the *Toxic Substances Control Act* (TSCA), the EPA is authorized to review and regulate both new chemicals and existing chemicals. As part of Agency's

chemical safety program, the TSCA Work Plan is designed to assess chemicals that may pose significant exposure to humans and/or the environment. If a substance poses a risk, the Agency may take risk reduction actions; otherwise these actions may not be required. Thallium and its compounds are not a part of this work plan, therefore it will not be considered for further risk assessment (US EPA, 2014).

7.2.2 United States – Guidelines

Numerous states provide different criteria for thallium and its compounds regarding their priorities for surface waters. The State of Florida has a surface water quality criterion applicable to non-mixing zones. The following classes listed in increasing order reflect the least degree of protection necessary, while the limited classes contain specific values for parameters such as alkalinity and pH. Thallium (CAS No. N/A): Class II: <6.3 µg/L, Class III and Class III-Limited (Fresh waters <6.3 µg/L and marine waters <6.3 µg/L) (US EPA, 2015b; US EPA, 2015a).

Table 1: State of Florida Surface Water Classifications

Class	Description
Class II	Shellfish Propagation or Harvesting
Class III	Fish consumption; Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife
Class III-Limited	Fish Consumption; Recreation or Limited Recreation; and/or Propagation and Maintenance of a Limited Population of Fish and Wildlife

For the State of Illinois, thallium (CAS No. 7440-28-0) has a general use aquatic life criterion of 86 µg/L(acute) and 11 µg/L(chronic), as well as a criterion for Lake Michigan of 54 µg/L(acute) and 15 µg/L(chronic). The acute criteria cannot be exceeded at any time, whereas the chronic criteria cannot be exceeded by an arithmetic average of at least four consecutive samples collected over at least a time frame of four days (Illnois Environmental Protection Agency, 2013).
The State of Massachusetts has deemed 11 thallium compounds as seen in the Act to no longer be on the Toxic or Hazardous Substance List. Yet they are still subject to reporting as defined in Section 313 of the *Emergency Planning and Community Right-to-Know Act* (EPCRA) (Commonwealth of Massachusetts, 2013).

7.2.3 European Union – Statutes

In the European Union, concern for chemical pollution of surface waters has administered the selection and regulation of priority chemical substances under Article 16 of the *Water Framework Directive 2000/60/EC* (European Commission, 2015). However, under Annex I of the Directive 2008/105/EC, thallium and thallium-containing compounds are not considered as priority substances on the list. Therefore no environmental quality standards (EQS) for thallium have been made since 2008 (European Commission, 2015a).

Under the *Classification, Labelling and Packaging Regulation*, a list of harmonized classification and labelling of hazardous substances can be found for thallium and its compounds. This includes the following (ECHA, 2008):

Table 2: List of thallium substances for harmonized classification and labelling

Substance	**CAS No.**
Thallium	7440-28-0
Thallium compounds, with the exception of those specified elsewhere in the Annex	-
Dithallium sulphate; thallic sulphate	7446-18-6
Thallium thiocyanate	3535-84-0

These substances listed are given Classification: Hazard Class and Category Code(s), Hazard Statement Code(s), as well as labelling requirements that include: pictograms and signal word code(s).

As part of the *Registration, Evaluation, Authorisation and Restriction of Chemicals* (REACH) regulation, thallium and its compounds are not listed on the *List of Restrictions* or the *Candidate List of Substance of Very High Concern for Authorisation*. Thus no recommendations have been considered for the addition of thallium and its compounds to the *Authorisation List.* This indicates that these substances are permitted to be used within the European market as there may not be a high concern for human health and/or the environment (ECHA, 2018).

8. Next Steps

8.1 Public Comment Period

Industry and other interested stakeholders are invited to submit comments on the content of this Risk Management Scope or other information that would help to inform decision-making (such as outlined in sections 3.2 or 3.3). Please submit additional information and comments prior to November14,2020. The Risk Management Approach document, which will outline and seek input on the proposed risk management instrument(s), will be published at the same time as the final Screening Assessment Report. At that time, there will be further opportunity for consultation.

Comments and information submissions on the Risk Management Scope should be submitted to the address provided below:

Program Development and Engagement Division
Environment and Climate Change Canada
Gatineau, Québec K1A 0H3
Telephone: 1-800-567-1999 (in Canada) or 819-938-3232
Fax: 819-938-5212
Email: eccc.substances.eccc@canada.ca

Companies who have a business interest in thallium and its compounds are encouraged to identify themselves as stakeholders. The stakeholders will be informed of future decisions regarding thallium and may be contacted for further information.

8.2 Timing of Actions

Electronic consultation on the draft Screening Assessment Report and Risk Management Scope: September 19, 2020 to November 14, 2020.This should include the submission of public comments, additional studies and/or information on thallium and its compounds.

Publication of responses to public comments on the draft screening assessment report and Risk Management Scope: concurrent to the publication of the screening assessment and, if required, the Risk Management Approach document.

Publication of responses to public comments on the Risk Management Approach, if applicable and if required, the proposed instrument(s): At the latest, 24-month from the date on which the Ministers recommended that thallium and its compounds be added to Schedule 1 of CEPA

Consultation on the proposed instrument(s), if required: 60-day public comment period starting upon publication of the proposed instrument(s).

Publication of the final instrument(s), if required: at the latest, 18-months from the publication of the proposed instrument or each proposed instrument.

These are planned timelines, and are subject to change. Please consult the schedule of risk management activities and consultations for updated information on timelines.

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ANNEX A. Substance Identity Information

CAS RN*	DSL or R-ICL name	Common name
7440-28-0 [a]	Thallium	Thallium
563-68-8	Acetic acid, thallium(1++) salt	Thallium(I) acetate
7791-12-0	Thallium chloride	Thallium chloride
10031-59-1 [b]	Sulfuric acid, thallium(1+) salt (1:?)	Thallium(I) sulfate
55172-29-7 [b]	Thallium chloride (201TlCl)	^{201}TlCl

[a] This substance was not identified under subsection 73(1) of CEPA but was included in this assessment as it is highly reactive when exposed to moisture in air and releases thallium ions under environmental conditions .

[b] This substance was not identified under subsection 73(1) of CEPA but was included in this assessment as it was identified for further consideration following prioritization of the Revised In Commerce List (R-ICL)

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