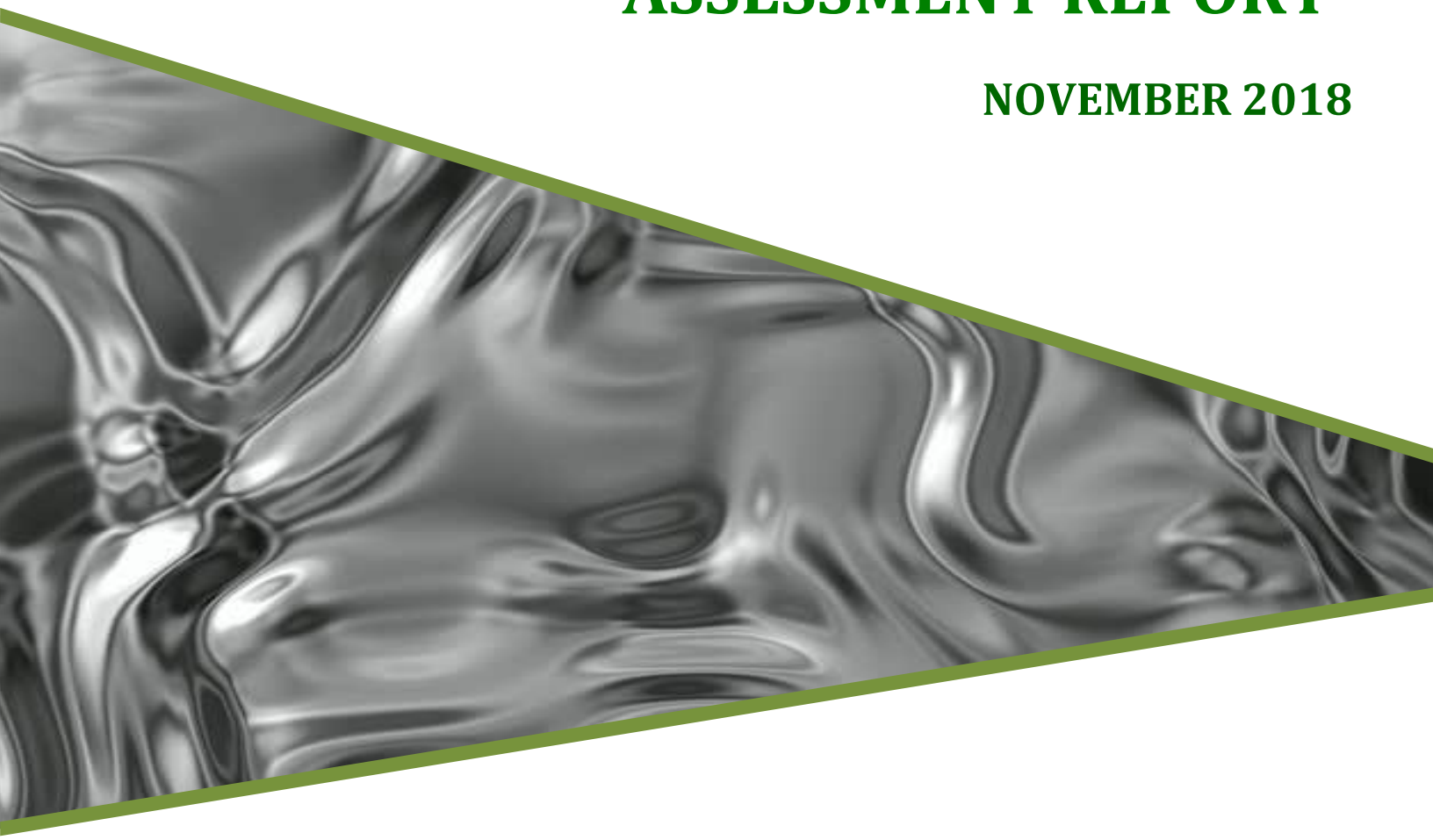
JAMAICA

MINAMATA INITIAL ASSESSMENT REPORT

NOVEMBER 2018



DEVELOPMENT OF THE MINAMATA INITIAL ASSESSMENT IN THE CARIBBEAN

(Jamaica, Saint Kitts and Nevis, Saint Lucia, Trinidad and Tobago)

MINISTRY OF ECONOMIC GROWTH AND JOB CREATION

BASEL CONVENTION

gef

UN environment
United Nations Environment Programme

MINAMATA CONVENTION ON MERCURY

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ABOUT THIS DOCUMENT

The Jamaica Minamata Initial Assessment Report was developed under the Project, “Development of Minamata Initial Assessment in the Caribbean: Jamaica, Saint Kitts and Nevis, Saint Lucia and Trinidad and Tobago”.

The Project is an enabling activity for the ratification and/or implementation of the Minamata Convention on Mercury. Funding was received from the Global Environment Facility (GEF) with the United Nations Environment (UN Environment; formerly United Nations Environment Programme – UNEP) acting as the Implementing Agency and the Basel Convention Regional Centre for Training and Technology Transfer for the Caribbean (BCRC-Caribbean) acting as the Executing Agency. Nationally, the Project was coordinated by the Ministry of Economic Growth and Job Creation (MEGJC).

The development of the Report was guided by the Biodiversity Research Institute which was contracted as the lead technical consultancy on the Project by the BCRC-Caribbean. The report consists of an inventory of mercury releases primarily based on 2016 data.

This inventory was performed in accordance with UN Environment's "Toolkit for identification and quantification of mercury releases", Inventory Level 2 (version 1.04, January 2017). Data collection and drafting of the inventory was conducted by National Project Coordinator, Dr. April Johnson.

The Report also includes an assessment of the policy, legislative and institutional frameworks in relation to the implementation of the Minamata Convention on Mercury which was developed by Dr. Winston McCalla.

Additional assessments and recommendations are outlined in chapters relating to populations at risk, education and awareness-raising strategies, and priorities for action to ensure the effective implementation of the Minamata Convention.

This Report was reviewed by the National Working Group comprising representatives from the relevant public sector agencies (Annex I).

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List of Abbreviations

AMAP	Arctic Monitoring and Assessment Programme
ASGM	Artisanal and Small-Scale Gold Mining
BAT	Best Available Techniques
BCRC-Caribbean	Basel Convention Regional Centre for Training and Technology Transfer in the Caribbean
BEP	Best Environmental Practices
BRI	Biodiversity Research Institute
BSJ	Bureau of Standards, Jamaica
CBOs	Community-based Organisation
CCCL	Caribbean Cement Company Limited
CCFL	Cold Cathode Fluorescent Lamps
CFLs	Compact Fluorescent Lamps
DMA	Direct Mercury Analyser
EC	European Commission
ECD	Electron Capture Detectors
EEFL	External Electrode Fluorescent Lamps
EPR	Extended Producer Responsibility
E-waste	Electronic Waste
FF	Fabric Filters
g Hg/t	Grams mercury per Tonne
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIS	Geographic Information System
Hg	Elemental mercury, CAS No. 7439-97-6
HPMV	High-Pressure Mercury Vapour Lamps
IPPs	Independent Power Producers
JAQMP	Jamaica Air Quality Management Programme
JBI	Jamaica Bauxite Institute

JCA	Jamaica Customs Agency
JPS	Jamaica Public Service Company Limited
kg Hg/y	Kilograms mercury per year
LEDs	Light Emitting Diodes
LFLs	Linear Fluorescent Lamps
LPG	Liquid Petroleum Gas
MAPs	Mercury-Added Products
MEGJC	Ministry of Economic Growth and Job Creation
MIA	Minamata Initial Assessment
MLGCD	Ministry of Local Government and Community Development
MOH	Ministry of Health
MOU	Memorandum of Understanding
MW	Megawatts
NEPA	National Environment and Planning Agency
NGOs	Non-governmental Organisations
NRCA	Natural Resource Conservation Authority
NSWMA	National Solid Waste Management Authority
NWC	National Water Commission
NWG	National Working Group
PAHO	Pan American Health Organization
PCA	Pesticides Control Authority
PM	Particulate Matter
ppb	Parts per Billion
PPE	Personal Protective Equipment
ppm, ww	Parts per Million, Wet Weight
QSPTF	Quick Start Programme Trust Fund
RDA	Residue Disposal Areas
RHAs	Regional Health Authorities

RSA	Residue Storage Areas
SEL	Specially Engineered Landfill
SIDS	Small Island Developing States
SRD	Standards and Regulation Division
STPs	Sewage Treatment Plants
t/y	Tonnes per Year
UNDP	United Nations Development Programme
UN Environment	United Nations Environment (formerly UNEP- United Nations Environment Programme)
UN ECOSCO	United Nations Economic and Social Council
UNIDO	United Nations Industrial Development Organization
UNITAR	United Nations Institute for Training and Research
US EPA	United States Environmental Protection Agency
UWI	University of the West Indies
WEEE	Waste Electrical and Electronic Equipment
WHO	World Health Organization
WRA	Water Resources Agency

Foreword

The Government of Jamaica is committed to the global thrust of regulating the many anthropogenic sources of mercury and mercury compounds. Jamaica was proud to have actively participated in the successful negotiation of the text of the **Minamata Convention on Mercury** which led to the historic adoption of the instrument in Kumamoto, Japan in October 2013. The country has shown its further support for the tenets of the treaty with the deposit of its instrument of ratification in July 2017.

Mercury is toxic to human health and has been rated by the World Health Organization (WHO) as one of the top ten (10) chemicals or groups of chemicals of major health concern. Indeed, the WHO estimates that among selected subsistence fishing populations, between 1.5/1000 and 17/1000 children show cognitive impacts caused by the consumption of fish containing mercury.

Small island developing states (SIDS), such as Jamaica, are not deemed to be major contributors to the global mercury budget. However, it is important that we continue to play our part in safeguarding the health and well-being of our population, especially the most vulnerable including women and children, and our fragile ecosystems from the significant negative effects of mercury and mercury compounds.

As a Party to the Minamata Convention, Jamaica is required to institute the necessary measures to, *inter alia*, address its major sources of mercury emissions and releases to the environment, phase-out and phase down specific categories of mercury-added products, manage mercury wastes and contaminated sites. This is a tall order and will require an integrated and coordinated approach by the Government with the assistance and partnership of our international development partners, civil society as well as the man in the street. In this regard, financial, technical, and technological capacity-building support as well as sustained public education, awareness, and education will be critical elements in ensuring that the country meets its legally-binding obligations under the Convention.

Effective implementation of the Minamata Convention will contribute to Jamaica's achievement of Agenda 2030 and the National Sustainable Development Goals (SDGs) as well as the other global sustainable development initiatives, particularly the SIDS Accelerated Modalities Of Action (SAMOA) Pathway.

This Minamata Initial Assessment (MIA) Project, entitled, '*Development of Minamata Initial Assessment in the Caribbean (Jamaica, St Kitts and Nevis, St Lucia, and Trinidad and Tobago)'* has allowed Jamaica to develop a national inventory in which its major

sources of mercury emissions and releases have been identified and quantified. The inventory will enable the country to prioritise areas for action, with respect to building the capacity required for the successful implementation of the Convention and to effectively engage in the environmentally sound management of mercury and mercury compounds on the island.

It is important that sustainable development practices are observed, including how products are produced and consumed, and how wastes are managed. Indeed, the results of this MIA report will guide policy makers, technocrats and our implementation partners in further improving the national management frameworks for chemicals and hazardous wastes.

Stakeholder participation in this Project was key to its success and the ministry with responsibility for the environment will continue to engage all relevant partners to undertake the necessary measures that will improve the relevant frameworks for the management of chemicals and hazardous waste. In this regard, the Government would like to express its sincere appreciation to the Global Environment Facility (GEF) for its financial support as well as the technical support provided by the United Nations Environment and the Basel Convention Regional Centre for the Caribbean (BCRC-Caribbean) in the implementation of the Project.

The outcomes of this MIA Report and the recommendations contained therein, will support the country's vision of making ***'Jamaica the place of choice to live, work, raise families and do business.'***

Time to Act – make mercury history.

Daryl Vaz, MP
Minister without Portfolio (land, environment, climate change, and investment)
Ministry of Economic Growth and Job Creation

October 2018

Executive Summary

On 17 July 2017, the Government of Jamaica deposited its instrument of ratification for the Minamata Convention on Mercury, thereby becoming a Party. The Minamata Convention aims to protect human health and the environment from the anthropogenic emissions and releases of mercury and mercury compounds. To assess the priorities for the implementation of the Minamata Convention's obligations, the Government of Jamaica participated in a Project entitled, "Development of the Minamata Initial Assessment in the Caribbean (Jamaica, Saint Kitts and Nevis, Saint Lucia, and Trinidad and Tobago)" (MIA Project).

The MIA Project aims to facilitate the ratification and early implementation of the Minamata Convention on Mercury within the Project implementing countries using scientific and technical information. The Project outputs within each of the Project countries were overseen by respective National Working Groups[1] comprising of representatives from relevant ministries and institutional bodies.

An inventory of mercury (Hg) releases and emissions in Jamaica was conducted using the "Toolkit for Identification and Quantification of mercury Releases" ('Toolkit'), made available by the Chemicals Branch of the United Nations Environment (formerly United Nations Environment Programme Chemicals). The Project utilised the Inventory Level 2 spreadsheet as it provided a more comprehensive assessment of mercury releases. It should be noted that in the Toolkit, the term "releases" is used to cover mercury emissions to air as well as releases to water, land and other output pathways. The methodology is based on mass balances for each mercury-release source sub-category, and so, estimations provided by the Toolkit have various uncertainties and complexities involved. The mercury releases estimated in this inventory should not be considered as final, but rather, an indication of the major source categories present in Jamaica and their likely magnitude. Major data gaps were also identified. These considerations will assist in the prioritisation of future actions.

[1] See Annex I - Membership of Jamaica's National Working Group

For Jamaica, the inventory primarily used 2016 data obtained through research, interviews and stakeholder questionnaires. However, for some sub-categories, data from the year 2016 were not available. Previous years or default calculations were used to develop estimates. Default calculations were based on the Toolkit's assumptions and may have resulted in over- or under- estimations of the actual mercury input. Data gaps were also noted for some sub-categories where no estimations could be made such as the use and disposal of polyurethane products with mercury catalysts, pharmaceuticals for human and veterinary use, cosmetics containing mercury, miscellaneous mercury-containing products, incineration of municipal and medical waste, and informal waste burning. The completed inventory Toolkit's spreadsheet, a list of the members of the National Working Group, and templates of questionnaires used for data collection, are included as Annexes to this document.

Results of the Mercury Inventory

Based on available data, it was estimated that the top three sectors for mercury releases in Jamaica are:

1. Alumina Production from Bauxite (bauxite production),
2. Consumer Products (whole life cycle), and
3. Waste Deposition, Landfilling and Wastewater Treatment

The estimated mercury releases by source and by output through various release pathways identified, are illustrated in Figures 1 and 2 below.

The total amount of mercury released in Jamaica for 2016 was approximately 4,348 kg. Primary (virgin) metal production (bauxite production) accounted for 75.7% of the estimated mercury output (3,292 kg Hg/y). It is important to note that releases calculated from this sector are likely to be over-estimations as they were based largely on assumptions made in the Toolkit for Hg input and output distribution factors. For example, an average Hg input factor for the concentration of Hg present in bauxite was used in the Toolkit but it was noted that the actual Hg content in the bauxite deposits in Jamaica vary greatly depending on location. Assumptions were also made on the output pathways for mercury releases. The Toolkit's spreadsheet estimated that 65% of

mercury releases from the bauxite sector were sent to general waste disposal at landfills or municipal waste disposal sites. However, feedback received from the Jamaica Bauxite Institute (JBI) indicated that regulations are in place at bauxite companies to dispose of all residues in an environmentally sound manner in Residue Disposal Areas or Residue Storage Areas. It should be noted, however, that a bauxite company indicated that mercury emitted during combustion processes in its alumina refining facility is in fact collected in filters and stockpiled for environmentally sound disposal.

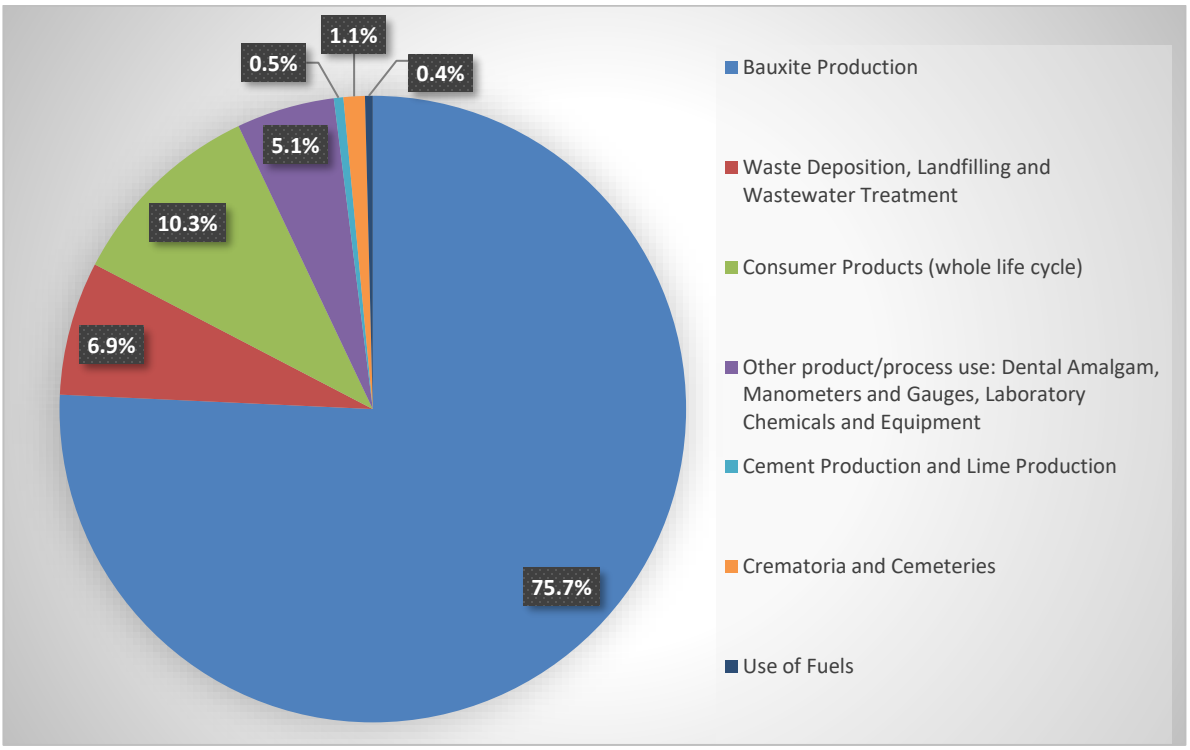

Figure 1: Estimations of total releases from the major sources of mercury identified in the mercury inventory conducted using primarily 2016 data

Therefore, it can be inferred that while bauxite production may be the top source of mercury releases in Jamaica, measures are currently in place to control and, where feasible, reduce the releases of mercury to land and water from this source. Further assessments can be carried out in the future to monitor the actual concentrations of mercury being released from the sector and determine if a national plan to further reduce releases should be developed.

The consumption of mercury-added products resulted in an estimated mercury release of 448 kg (10.31%). This estimation was mainly attributed to the use and disposal of mercury-added electrical switches and relays over the last twenty (20) years, which resulted in 308.46 kg of mercury being released. This was based on the assumption that all switches and relays used in Jamaica contained mercury and the releases were determined using default calculations based on population data and electrification rate. Therefore, mercury releases estimated from electrical switches and relays may be an over-estimation. Releases from mercury-added thermometers (92.21 kg), light sources (32.80 kg) and batteries (14.84 kg) also contributed to the consumer products category. It was determined that the consumer products identified were not produced in Jamaica but imported for use. Mercury-added skin lightening creams were identified as being both manufactured and consumed in Jamaica. This data, however, could not be quantified at the time of the inventory. Measures[2] must be instituted to promote the phase-out of such products by 2020.

Approximately seven per cent (7.0%) of mercury releases in Jamaica were due to the deposition of mercury-added wastes to disposal sites and the releases of mercury wastes in waterways. This percentage was determined after the mercury input to waste from other categories was subtracted to avoid double-counting. Measures must be enforced to ensure the separation of mercury wastes and its management in an environmentally sound manner.

Lesser sources of mercury releases were found to include the use and disposal of dental amalgam, manometers and gauges and laboratory chemicals and equipment (5.06%); crematories and cemeteries (1.1%); cement production (0.49%) and; combustion of coal, mineral oils, and charcoal (0.4%).

Figure 2 illustrates the releases of mercury via various pathways. The main pathways are to air, land and water. However, intermediate pathways are also identified such as by-products and impurities, general waste and sector-specific treatment/disposal. It is important to note that totals presented in Figure 2 for waste deposition, landfilling and

[2] Article 4(1) of the Minamata Convention provides for the phase-out of mercury-added products included in Part I, Annex A, except where an exclusion is specified in Annex A or the Party has a registered exemption pursuant to Article 6.

wastewater treatment do not account for the double-counting in other sectors. When determining total mercury releases according to sectors, only a percentage of the total presented in Figure 2 is applied.

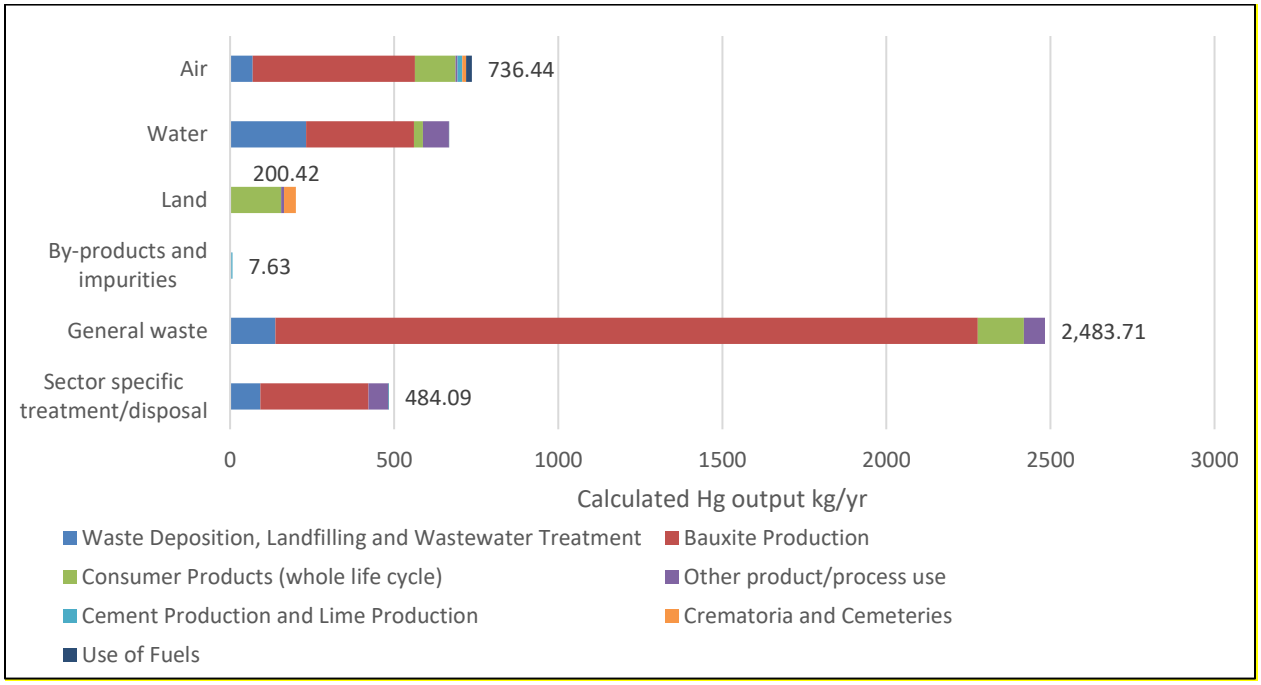

Figure 2[3]: Estimations of releases to each output pathway from the major sources of mercury identified in the mercury inventory conducted using 2016 data

Mercury released to general waste was determined to have the highest output with 2,483.71 kg released in 2016. However, this estimation was based on the assumption that 2,140 kg of mercury waste from the bauxite industry was disposed of in general waste which is likely an over-assumption.

Mercury emitted to air was identified as the second highest output pathway, mainly due to emissions from bauxite processes. However, as discussed previously, measures are already in place within the bauxite sector to manage the emissions of mercury to air from the Bayer process.

In terms of mercury or mercury compound stocks, it was determined that there were no

[3] Totals presented in Figure 2 show the full estimations for mercury releases due to waste deposition and waste water treatment. When determining mercury releases from sectors, only a percentage of these estimations were used to avoid double-counting.

significant[4] stocks in Jamaica, though further research is recommended.

Strategies for Identification of Contaminated Sites and Assessment of Risks to Human Health

The development of a strategy to identify sites contaminated by mercury and mercury-containing products was initiated under this Project. National-scale data on potential point sources of mercury as well as ecosystems that might be sensitive to mercury inputs were incorporated into a model[5] to help identify areas within the country that are sensitive to mercury inputs based on methylmercury generation and availability. The results showed that watersheds surrounding Spanish Town are the most sensitive to mercury contamination, and that watershed sensitivity to mercury did occur in areas in which bauxite plants were present, though the extent could not be determined from the information obtained. The relationship between mercury sensitivity and disposal sites was not confirmed from the information obtained. The model developed may be used by the Government of Jamaica to further its assessments in identifying mercury contaminated sites. Additionally, Technical Guidelines for the management of contaminated sites are being developed under the Minamata Convention in keeping with Article 12(3). These Guidelines, once finalized and adopted, will also be useful in assisting Jamaica to further identify, assess and characterize its sites contaminated with mercury or mercury compounds.

Exposure to elemental mercury and mercury compounds can pose a higher risk to certain populations that are more sensitive to its effects or have an increased frequency of exposure, including pregnant women and women of childbearing age, foetuses, new-borns and young children. Also at risk are individuals with health-related preconditions, populations with a regular diet of contaminated high trophic level aquatic organisms, individuals who consistently use mercury-added products such as skin-lightening creams with mercury, people living in areas that are more susceptible to environmental contamination by mercury such as locations surrounding island's waste disposal sites, power plants, bauxite mining sites and other industrial facilities that release mercury and

[4] The term 'significant' is deemed to relate to the individual stocks of mercury or mercury compounds exceeding 50 metric tonnes

[5] The model used as outlined by Buck and Burton, 2017

mercury compounds into the environment, as well as, workers who are frequently exposed to mercury.

The risk of exposure, through occupations in the mining and quarrying, manufacturing, construction, electricity, gas and water supply, waste handling sectors and first responders, was estimated to be greater in men. On the other hand, the risk of mercury exposure through medical-related work was estimated to be greater in women. These trends allow for the development of more gender-sensitive communication strategies that can target the sexes differently to achieve maximum benefit in Jamaica.

Major Findings of the Policy, Regulatory and Institutional Framework Assessment

An assessment of the policy, regulatory and institutional frameworks relating to mercury management in Jamaica was conducted by Dr Winston McCalla.

With respect to the obligations outlined under Articles 8 and 9 of the Minamata Convention, the National Resources Conservation Authority (Air Quality) Regulations (2006) and the National Resources Conservation Authority (Wastewater and Sludge) Regulations (2013) establish controls to ensure the management of mercury emissions and releases in Jamaica, respectively. Recommendations for activities to be undertaken in the short-term (six to twelve months) include the institution of measures to ensure enforcement of emissions and releases controls, under the relevant Regulations.

In terms of the obligations to phase-out mercury-added products as reflected under Article 4, Part I of the Convention, recommendations for activities in the medium-term (twelve to eighteen months) include the enactment of legislation by Ministry of Health to, *inter alia*, ban the sale of mercury-containing cosmetics[6] and that the Ministry of Industry, Commerce, Agriculture and Fisheries should ban/restrict the importation of mercury and mercury compounds through the Trade Act.

Another important area of implementation identified is the need for institutional strengthening. The implementation process would involve the need for a sound and proactive communication plan, and a carefully designed governance and accountability

[6] Part 1 of Annex A lists, *inter alia*, cosmetics (with mercury content above 1ppm) including skin lightening creams and soaps, not including eye area cosmetics where mercury is used as a preservative and no effective or safe substitute preservatives are available.

action plan. The Ministry of Economic Growth and Job Creation, in its capacity as the Minamata Convention Focal Point Ministry is responsible for coordinating the implementation of the Minamata Convention on Mercury, but this would have to be done in collaboration and cooperation with other designated agencies that have specific responsibility for various areas for the implementation of the Minamata Convention on Mercury. The implementation would also involve other lead Ministries and the relevant coordinating bodies to address: institutional development, capacity building, information, education and communication; and collaborating with national level departments / agencies that have demonstrated capacity and expertise in managing aspects of the implementation of the Minamata Convention on Mercury.

A steering committee made up of representative organisations with various roles and responsibilities for the effective implementation of the Convention should also be established. This may be done by formalising the existing National Working Group under the MIA project.

Summary of recommended priority actions to be undertaken to facilitate the implementation of the Minamata Convention

The Government of Jamaica, as Party to the Minamata Convention on Mercury, has prioritised the following activities:

a) Undertake measures to control, and where possible to reduce emissions from new and existing emission and release sources of mercury and mercury compounds;
b) Institute measures or strategies to address mercury-added products as specified under Article 4 and Annex A of the Convention;
c) Establish interim mercury storage sites, as appropriate;
d) Develop and implement programmes to address priority mercury waste streams;
e) Identification, characterisation and remediation of sites contaminated with mercury and mercury compounds;
f) Develop and implement strategies and programmes to protect identified at-risk populations; develop and implement science-based educational and preventative programmes.

Introduction

A. Mercury in the Environment

Mercury (Hg) is a naturally occurring element in the Earth's crust. It is contained in several minerals and is commonly found as a reddish-brown compound called cinnabar; mercury sulphide. Mercury cannot be destroyed and once released from the crust and mobilised into the environment, it cycles between air, land and water. It may be eventually removed naturally by burial in deep ocean sediments. The biogeochemical cycle of transport and mobilization process of mercury is illustrated in Figure 3.

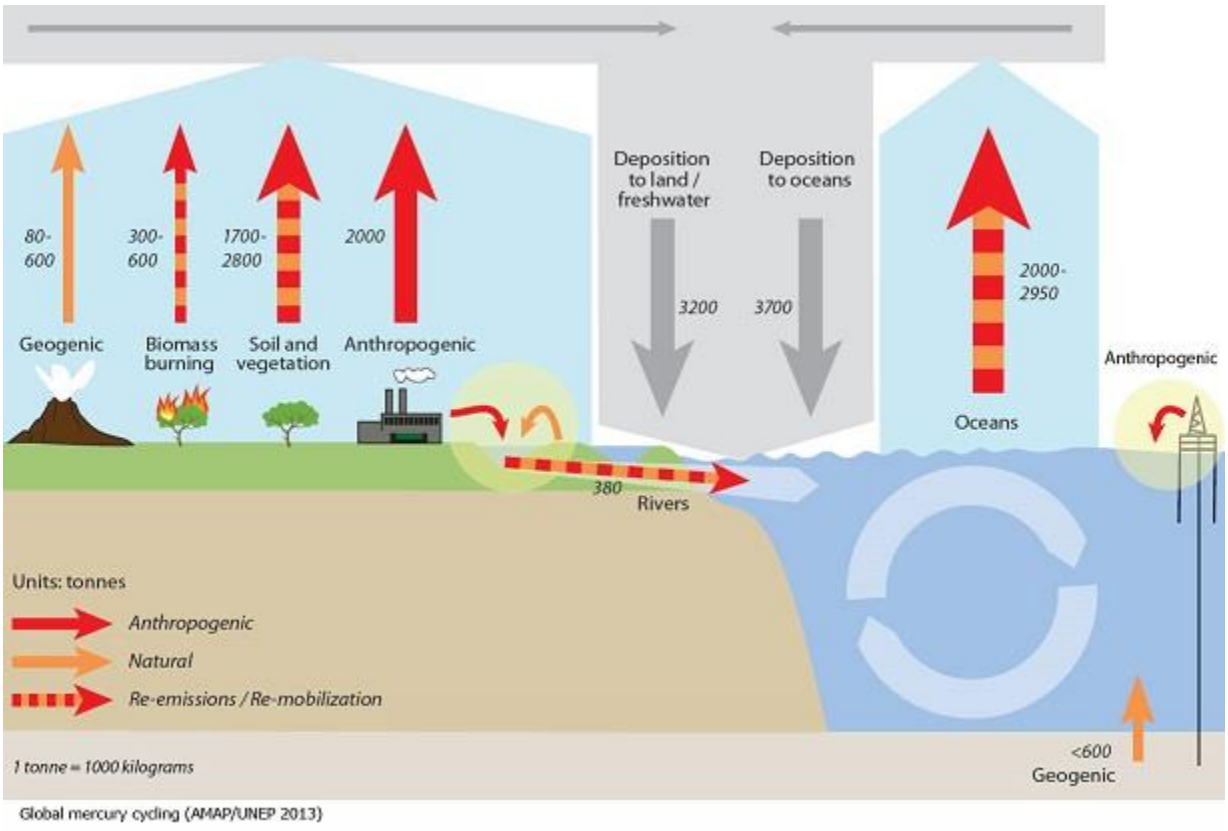

Figure 3: The Global Mercury Cycle (Values in tonnes of mercury)
(Source: AMAP/UNEP, 2013)

As a highly toxic chemical element, mercury is considered one of the top ten (10) chemicals of major public health concern (WHO, 2017). It can damage the central nervous system and affect numerous organs, resulting in neurological and behavioral disorders. Symptoms include tremors, insomnia, memory loss, neuromuscular effects, headaches, and cognitive and motor dysfunction (UN Environment, 2017a). The severe

effects caused by exposure to mercury in humans are largely seen in fetuses and young children due to their developing nervous systems.

Mercury can enter the human body through inhalation, direct contact with the skin or ingestion of contaminated food or water. Some common sources of exposure for humans include dental amalgam fillings, occupational exposure, skin-lightening creams and the consumption of fish. When mercury is deposited into water bodies it is converted into methylmercury by the action of bacteria. This highly toxic organic form of mercury biomagnifies up the food web and exposure to humans is primarily through their diet of large predatory fish, which generally contain higher levels of methylmercury. This is discussed further in Section 4.1.1 of this report.

The different sources in which mercury is released into the environment can be grouped together as follows:

Natural Sources

Volcanic eruptions, weathering of mercury-containing rock materials, forest fires and ocean vents are some of the natural processes that release mercury from the earth's crust into the environment. Volcanic eruptions can release as much as 57 tonnes of mercury per year (t Hg/y), whilst degassing activities may release as much as 37.6 t Hg/y (Nriagu and Becker, 2003). Natural sources of mercury are not addressed under the Minamata Convention.

Anthropogenic Sources

Human activities, such as mining, combustion, production of metal from ores, the intentional use of mercury in products and processes and the re-mobilisation of previous mercury releases have led to an increase in the mobilisation of mercury into the environment. Anthropogenic sources can account for 30% of the mercury emissions in the atmosphere (AMAP/UNEP, 2013).

In 2013, UN Environment (formerly UNEP) with the Arctic Monitoring and Assessment Programme (AMAP) published the Global Mercury Assessment 2013 in which the major sources of global mercury emissions were identified and assessed. It was found that artisanal and small-scale gold mining was identified at the main source of mercury

emissions as large amounts of elemental mercury are often used in the process. Other key sources included coal combustion, industrial processes, and the use and disposal of mercury-added products, such as thermometers and compact fluorescent light bulbs. The estimations for the top sources of mercury emissions are shown in Figure 4, with the estimated releases from Central America and the Caribbean highlighted in darker blue. From this region, the largest estimated source of mercury releases was due to artisanal and small-scale gold mining operations in countries, such as Guyana and Suriname.

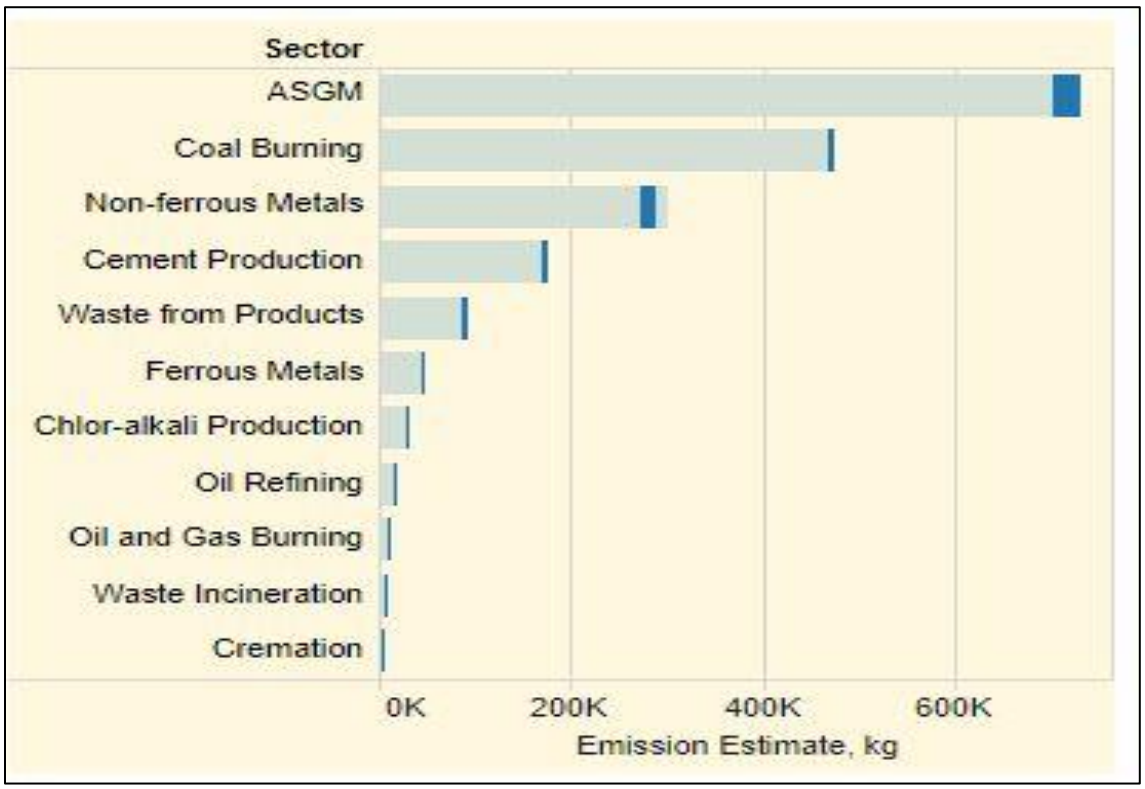

Figure 4: Estimations of global emissions (light blue) and Central American and Caribbean emissions (dark blue) of mercury based on 2010 data from various sources (Source: AMAP/UNEP, 2013)

B. Minamata Convention on Mercury

To address the negative impacts posed by the release of mercury, a global treaty, the Minamata Convention on Mercury was developed. Article 1 of the Convention outlines its objective which is to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds. The text of the Minamata Convention was adopted on October 10, 2013 and the Convention entered into force on

August 16, 2017. The Convention regulates, *inter alia*, mercury supply, sources and trade; mercury-added products and processes; interim storage and disposal of mercury, its compounds and mercury waste; and the emissions and releases of mercury.

The Government of Jamaica became a signatory to the Minamata Convention on Mercury when it was opened for signature on 10 October 2013. On 19 July 2017, the Government of Jamaica deposited its instrument of ratification.

As of November 2018, Antigua and Barbuda, Cuba, Dominican Republic, Guyana, Jamaica, Saint Kitts and Nevis and Suriname are the countries in the Caribbean region which are Parties to the Convention.

C. Project Background

The Project entitled, "Development of the Minamata Initial Assessment in the Caribbean (Jamaica, Saint Kitts and Nevis, Saint Lucia, and Trinidad and Tobago)", or the MIA Project, aims to facilitate the ratification and early implementation of the Minamata Convention on Mercury through the use of scientific and technical knowledge in conducting an inventory of mercury releases (and emissions)[7] in the respective countries. The MIA Project will assist the Government of Jamaica in its implementation of the Convention by providing a general overview of the current situation regarding mercury and its compounds in the country.

The MIA Project is funded by the Global Environment Facility (GEF), with the United Nations Environment (UN Environment; formerly the United Nations Environment Programme - UNEP) acting as the implementing agency. The Basel Convention Regional Centre for Training and Technology Transfer in the Caribbean (BCRC-Caribbean) is acting as the project executing agency. The Ministry of Economic Growth and Job Creation (MEGJC) is acting as the national coordinating agency.

The development of an inventory of mercury releases in each participating country is a key component of the Project, as it informs participating countries of their national

[7] Under the Minamata Convention, the term "releases" is typically related to mercury released to land and water while the term "emissions" refers to mercury released to air. Under the UN Environment Toolkit, "releases" is used to describe mercury released to all media, including air. For this report, the term "mercury releases" will be used predominantly as described under the UN Environment Toolkit.

mercury situation and subsequently assist in applying action to increase their capacity in mercury management. The sharing of experiences and lessons learned throughout the Project is also expected to be an important contribution to other countries in the region. The aim of the project is to be achieved through the six (6) components outlined in Table 1.

Table 1: Outline of the project components, outcomes and the expected outputs as stated in the MIA Project Document

Project Component	Project Component Outcome	Project Component Output
1. Establishment of Coordination Mechanism and organisation of process	Participating countries make full use of enhanced existing structures and information available dealing with mercury management to guide ratification and early implementation of the Minamata Convention	Technical support provided for the establishment of National Coordination Mechanisms and organization of process for the management of mercury
2. Assessment of the national infrastructure and capacity for the management of mercury, including national legislation	Full understanding of comprehensive information on current infrastructure and regulation for mercury management enables participating countries to develop a sound roadmap for the implementation of a national legal framework for the ratification and early implementation of the Minamata Convention	Assessment prepared of the national infrastructure and capacity for the management of mercury, including national legislation
3. Development of a mercury inventory using the UN Environment mercury Toolkit and strategies to identify and assess mercury contaminated sites	Enhanced understanding on mercury sources and releases facilitated the development of national priority actions	Mercury inventory developed using the UN Environment Mercury Toolkits and strategies to identify and assess mercury contaminated sites
4. Identification of challenges,	Improved understanding on	Technical support provided for

Project Component	Project Component Outcome	Project Component Output
needs and opportunities to implement the Minamata Convention on Mercury	national needs and gaps in mercury management and monitoring enables a better identification of future activities	identification of challenges, needs and opportunities to implement the Minamata Convention on Mercury
5. Preparation, validation of National MIA reports and implementation of awareness-raising activities and dissemination of results	Participating countries and key stakeholders make full use of the MIA and related assessments leading to the ratification and early implementation of the Minamata Convention on Mercury	Technical support provided for preparation and validation of National MIA reports and implementation of awareness-raising activities and dissemination of results
6. Information exchange, capacity-building and knowledge-generation	Enhanced communication, support and training, facilitates the development of the Minamata Initial Assessment by participating countries and build the basis for future cooperation and regional approaches for mercury management	Information-exchange undertaken and capacity building and knowledge-generation for mercury management provided

To acquire information and develop a comprehensive national mercury management strategy for mercury releases, stakeholder participation was critical. A list of stakeholders who participated in this process is provided in Annex II. The stakeholders, which included professionals with experience in dealing with chemicals and environmental issues, waste disposal, industrial activities, and representatives from relevant ministries, academic institutions and non-governmental organisations, were invited to the “National Inception Workshop and Mercury Inventory Toolkit Training” held on 5 April 2017 and the National Validation workshop held on 30 October 2017.

Sector-specific questionnaires were then administered by BRI at the inception workshop using guidelines developed by UNITAR (Annex III). Face-to-face interviews were also conducted where necessary.

The inventory was conducted with the use of the "Toolkit for Identification and Quantification of Mercury Releases" (Toolkit), made available by the Chemicals Branch of the United Nations Environment (UN Environment Chemicals). The Toolkit is designed to produce a simple and standardised methodology and database to inform the national mercury inventory. It outlines a UN Environment-recommended procedure to facilitate the development of consistent and comparable source inventories. The steps involved include:

1. The identification of the main mercury source categories present in the country;
2. The refining of the mercury source categories identified into further sub-categories in order to identify the individual activities that potentially release mercury. Qualitative information on the activities was also gathered.
3. The development of a quantitative inventory. The Inventory Level 2 version of the Toolkit was utilised in this MIA Project as it provided a more comprehensive look at the releases of mercury. Estimations are calculated via equations and procedures specific to the source types identified.
4. The compilation of the standardised mercury inventory and identification of data gaps which will build on the country's knowledge-base on mercury.

It is important to note that in calculating estimations of mercury releases using the Toolkit, there may be various uncertainties and complexities involved. As such, for each mercury source sub-category present, there will be an estimate of releases to all media where data are sufficient, and an indication of the likely magnitude if full data are unavailable. Major data gaps will also be identified. These considerations will assist in the interpretation of results and prioritisation of future actions.

This inventory was developed from February 2017 to November 2017 using data obtained primarily from the year 2016. In cases where 2016 data was unavailable estimations were used using data either from previous years or using default calculations provided by the Toolkit. Further details are provided in the respective sections in the report.

The mercury inventory spreadsheet for Jamaica is presented at Annex IV.

Chapter I: National Background Information

1.1 Country Profile

1.1.1 Geography and Population

Jamaica is the third largest country in the Greater Antilles of the Caribbean, with a mainland area of 10,991 square kilometres. The country is divided into 14 parishes (Figure 5). Jamaica's 2016 population of 2,881,355 (World Bank Group, 2018) is largely situated in the capitals of its main parishes, and is most dense in the Kingston, Saint Andrew, and Saint Catherine parishes surrounding the country's capital (Statistical Institute of Jamaica, 2011).

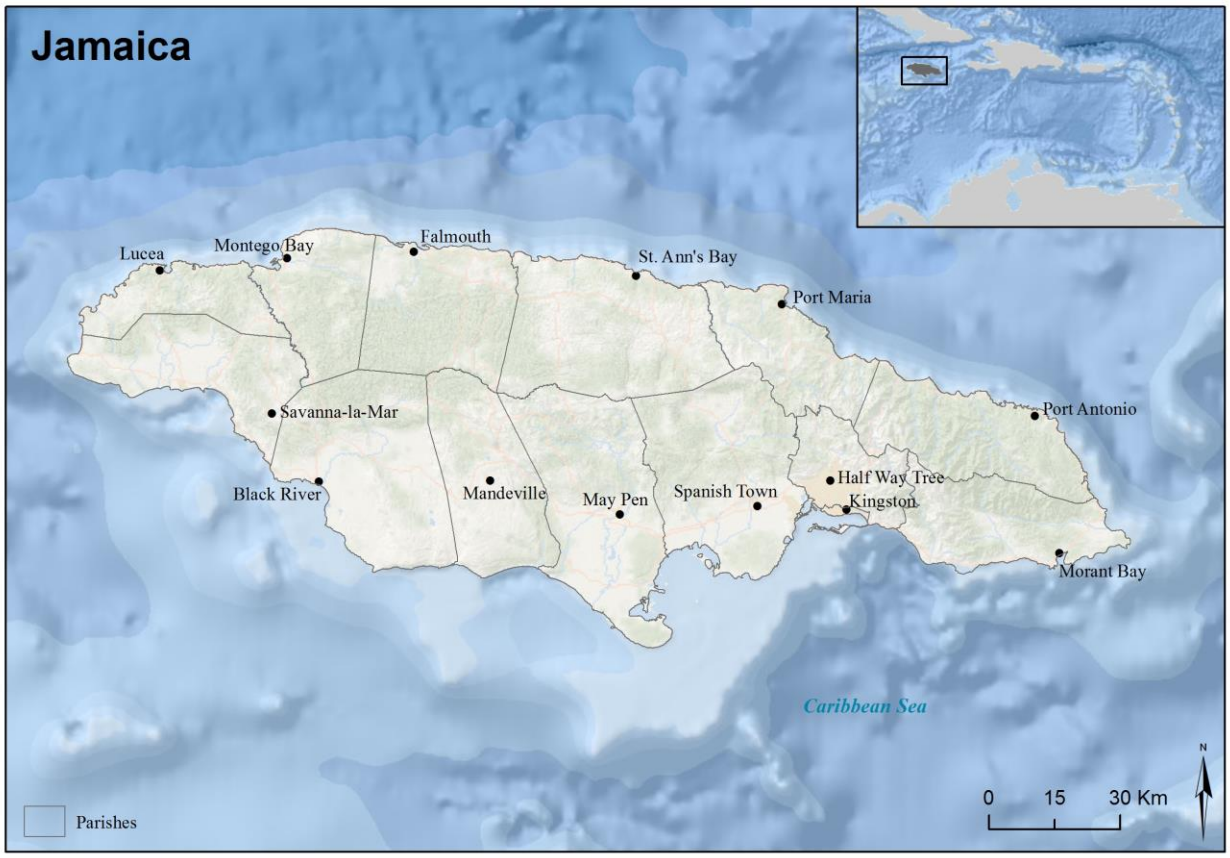

Figure 5: Map of Jamaica
(Source: BRI, 2018)

Naturally occurring mercury is widely distributed in Jamaica's soils. The range of mercury concentrations in surface soils is 40-830 parts per billion (ppb) compared with 100-500 ppb for global soils (International Centre for Environmental and Nuclear

Sciences, 1995). Figure 6 shows the distribution of mercury concentrations in soils across the island.

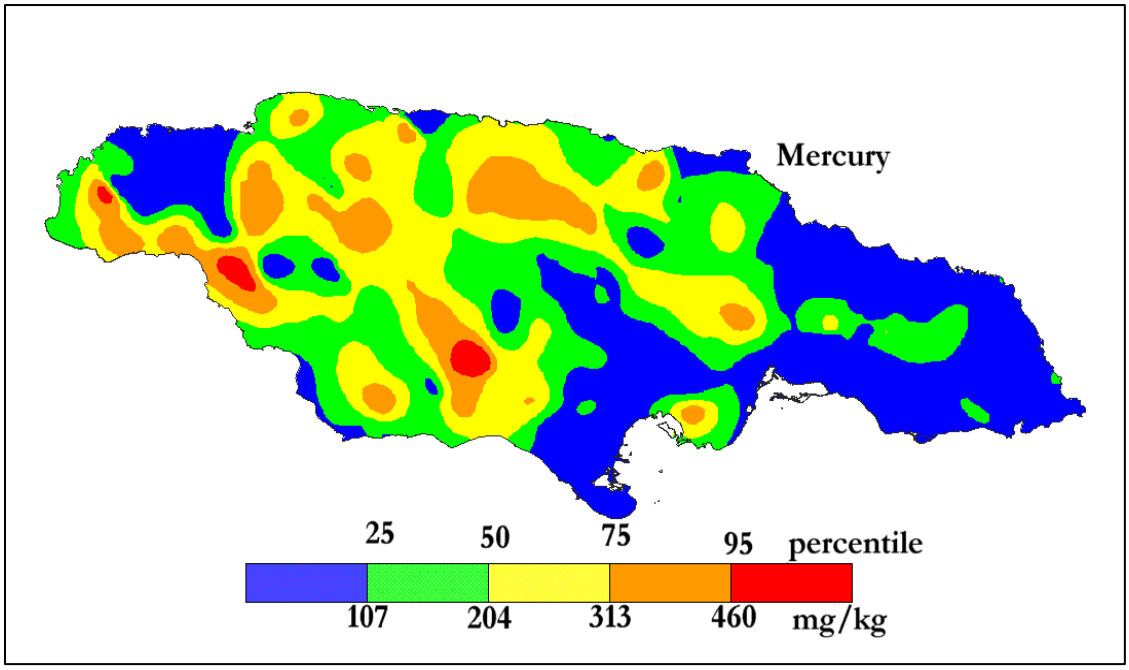

Figure 6: Mercury distribution across Jamaica
(Source: International Centre for Environmental and Nuclear Sciences, University of the West Indies, 1995)

1.1.2 Economic Profile

The main economic sectors in Jamaica are: Agriculture, Forestry and Fishing; Mining and Quarrying; Construction; Services; and Manufacturing (Statistical Institute of Jamaica, 2017). The Services sector is the largest employer, and is accounted for approximately 75% of the country's Gross Domestic Product (GDP) in 2016 (Figure 7). Manufacturing is the second largest contributor followed by Agriculture, Forestry and Fishing and the Construction Industry. According to 2016 data, the Mining and Quarrying Sector, which is comprised mainly of bauxite and alumina production, contributed to approximately 2% of Jamaica's GDP.

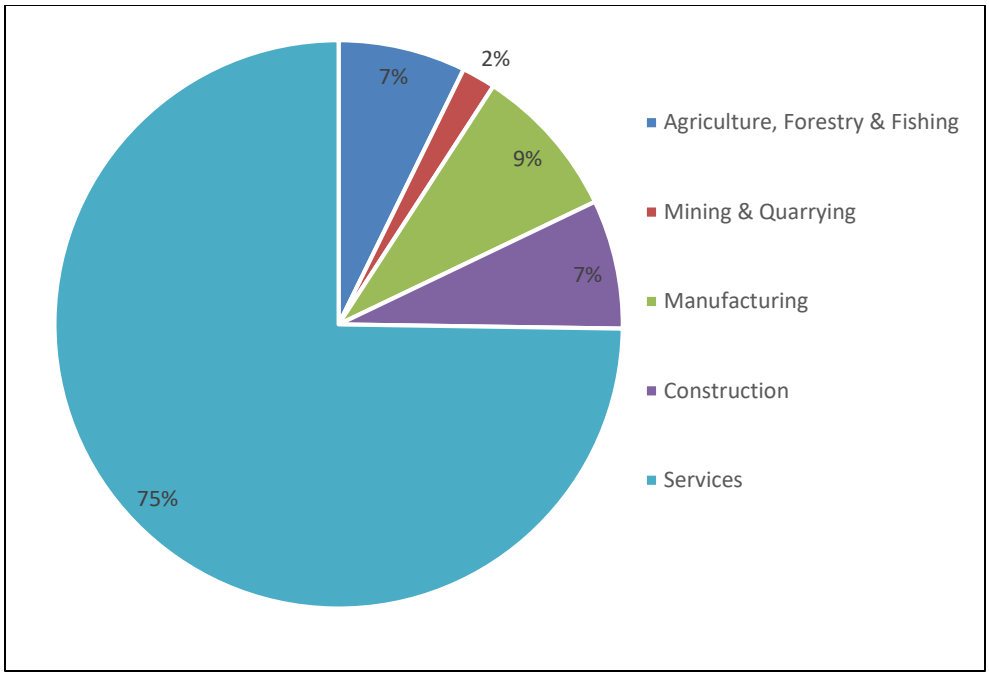

Figure 7: Sectors contributing to Jamaica's 2016 GDP (shown as a Percentage) (Data Source: The Statistical Institute of Jamaica, 2017)

The main mineral resources of Jamaica are bauxite, limestone, sand, and gravel (STATIN, 2017). Bauxite mining and refining for use in alumina production is a contributor to mercury releases in Jamaica even though the industry has declined in recent years.

1.2 Presence of Mercury in Jamaica

According to a 2010 inventory conducted by UN Environment (formerly UNEP) with the Arctic Monitoring and Assessment Programme (AMAP) and published in 2013, the major sectors in Jamaica contributing to mercury emissions were: cement production (unintentional); waste from products (intentional); and oil and gas burning (unintentional) (Figure 8). Data used in this AMAP inventory was based on assumptions and excluded detailed information on alumina production.

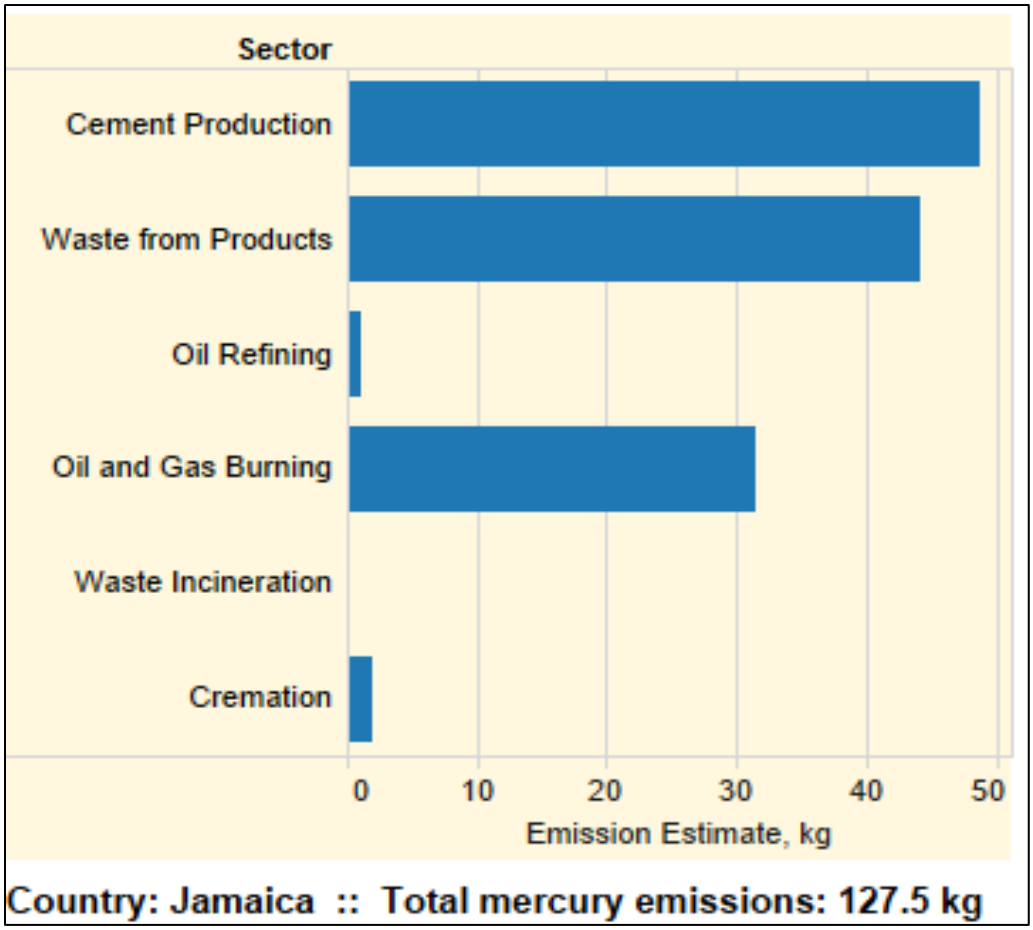

Figure 8: Mercury sources according to 2010 AMAP inventory (Source: AMAP/UNEP, 2013)

An updated inventory was conducted in 2016, under the Mercury Storage and Disposal Project[8] in the Caribbean (Jamaica, Suriname and Trinidad and Tobago). This inventory suggested that the major contributors to mercury releases in Jamaica were: primary metal production (alumina production from bauxite), use and disposal of products (excluding dental amalgam), and waste deposition (Figure 9). These results are estimations made from the UN Environment Level 1 Mercury Inventory Toolkit based on assumptions and default calculations and were not fully representative of Jamaica's mercury releases. Unlike the 2010 AMAP inventory, this project utilised data from the

[8] This project is a follow-up to the 2009 Norway funded project "Reducing Mercury Supply and Investigating Safe Long-Term Storage Solutions", also known as "UNEP Mercury Storage Project". The project serves as a catalyst in the action towards ratification of the Minamata Convention and it is part of the continuing work to provide technical assistance to countries in search for environmentally sound storage and disposal for mercury, identified as a priority of governments.

bauxite industry and demonstrated the significance of this sector on mercury releases. Mercury is present as an accessory element in bauxite which is used to manufacture alumina.

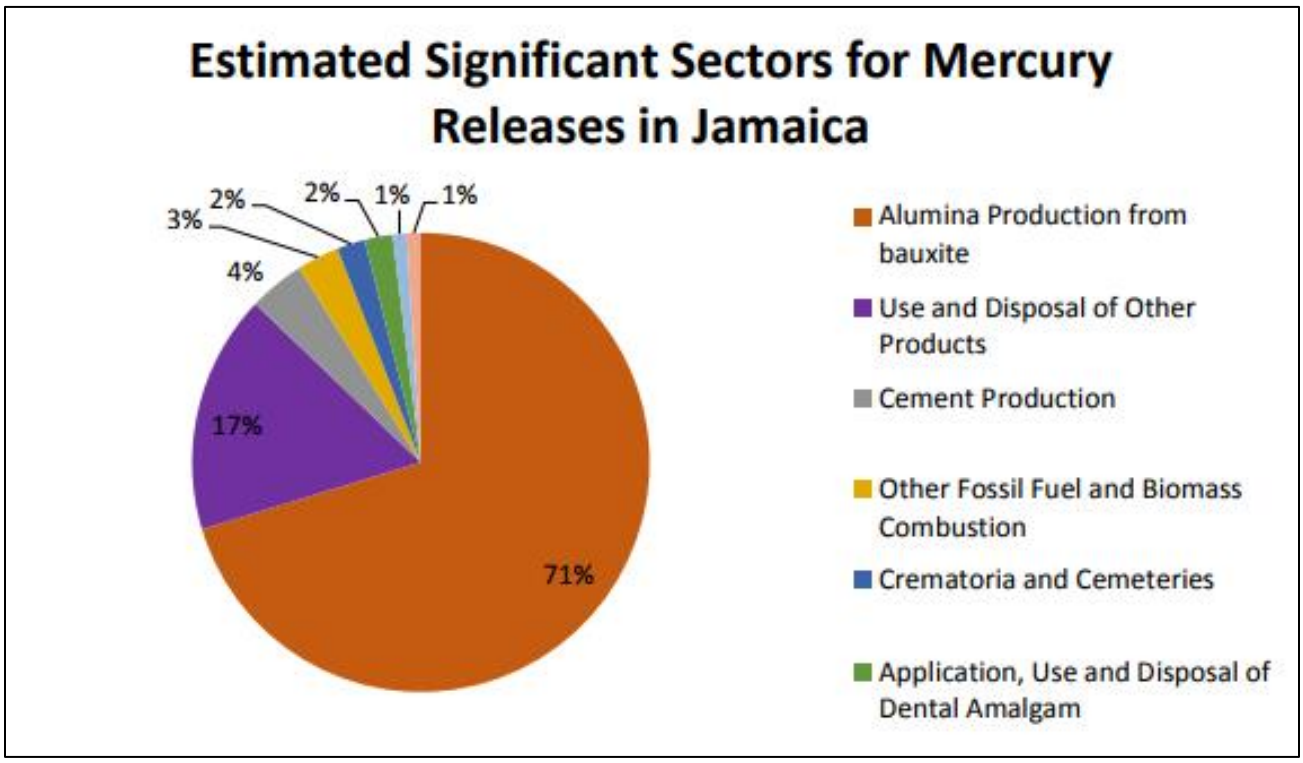

Figure 9: Summary of mercury inventory results from 2016 Mercury Storage and Disposal Project, based on 2015 data
(Source: BCRC-Caribbean, 2016)

In addition to the assessments of mercury releases from various sectors in Jamaica, preliminary studies of mercury in fish have also been conducted. Studies have shown that mercury is present in certain species of fish consumed by the Jamaican population (Ricketts et al, 2016). Placental samples of 100 pregnant women in Jamaica were assessed for mercury content in this study. When the results of the assessment were compared to the fish intake of the participants, it was found that Cod was the main fish species that contributed to methylmercury exposure. Similarly, Ardjomand-Hessabi et al. (2013) found that blood mercury concentrations were higher in a subset of Jamaican children between 2-8 years of age who frequently ate certain types of seafood, such as salt-water fish, sardines or mackerel. Mercury concentrations in locally caught fish were not assessed under this Project.

Further investigation into the quantities of mercury being released into the environment is needed to fully understand what should be done to eliminate this toxic metal and reduce its potential impact on human health and the environment.

Chapter II: Mercury Inventory and Identification of Emissions and Resources

2.1 Summary of Mercury Releases, Stockpiles, and Supply and Trade

2.1.1 Mercury Release Source Types Present

At the National Project Inception Workshop held in April 2017 in Jamaica, stakeholders from the relevant sectors in the country were invited to confirm which source categories were present and required further assessment in the inventory.

Table 2 shows the mercury release source categories identified in the Toolkit (Level 2) and indicates sources that are applicable to Jamaica at the time of the inventory. The contribution to mercury releases in Jamaica from some source sub-categories identified as possibly being present, was not confirmed, and it is recommended that the input factors, activity rates and output quantities should be determined in the future. The categories identified as being absent will not be discussed further in the report.

Table 2: Identification of mercury release sources in Jamaica; Sources present (Y), absent (N), and possible but not positively identified (?)

Cat. no.	Source category	Source presence (y/n/?)
5.1	**Main category: Extraction and use of fuels/energy sources**	**Y**
5.1.1	Coal combustion in power plants	N
5.1.2.1	Coal combustion in coal fired industrial boilers	N
5.1.2.2	Other coal use	N
5.1.3	Mineral oils - extraction, refining and use	Y
5.1.4	Natural gas - extraction, refining and use	Y
5.1.5	Other fossil fuels - extraction and use	N
5.1.6	Biomass fired power and heat production	Y
5.1.7	Geothermal power production	N
5.2	**Main category: Primary (virgin) metal production**	**Y**
5.2.1	Mercury (primary) extraction and initial processing	N
5.2.2	Gold (and silver) extraction with mercury amalgamation processes	N
5.2.3	Zinc extraction and initial processing	N
5.2.4	Copper extraction and initial processing	N
5.2.5	Lead extraction and initial processing	N
5.2.6	Gold extraction and initial processing by methods other than mercury amalgamation	N

Cat. no.	Source category	Source presence (y/n/?)
5.2.7	Aluminium extraction and initial processing	Y
5.2.8	Other non-ferrous metals - extraction and processing	N
5.2.9	Primary ferrous metal production	N
5.3	**Main category: Production of other minerals and materials with mercury impurities**	**Y**
5.3.1	Cement production	Y
5.3.2	Pulp and paper production	N
5.3.3	Production of lime and light weight aggregates	Y
5.4	**Main category: Intentional use of mercury in industrial processes**	**N**
5.4.1	Chlor-alkali production with mercury-technology	N
5.4.2	VCM production with mercury catalyst	N
5.4.3	Acetaldehyde production with mercury catalyst	N
5.4.4	Other production of chemicals and polymers with mercury	N
5.5	**Main category: Consumer products with intentional use of mercury**	**Y**
5.5.1	Thermometers with mercury	Y
5.5.2	Electrical switches and relays with mercury	Y
5.5.3	Light sources with mercury	Y
5.5.4	Batteries with mercury	Y
5.5.5	Polyurethane with mercury catalysts	?
5.5.6	Biocides and pesticides with mercury	N
5.5.7	Paints with mercury	N
5.5.8	Pharmaceuticals for human and veterinary uses	?
5.5.9	Cosmetics and related products with mercury	Y
5.6	**Main category: Other intentional product/process use**	**Y**
5.6.1	Dental mercury-amalgam fillings	Y
5.6.2	Manometers and gauges with mercury	Y
5.6.3	Laboratory chemicals and equipment with mercury	Y
5.6.4	Mercury metal use in religious rituals and folklore medicine	N
5.6.5	Miscellaneous product uses, mercury metal uses, and other sources	Y
5.7	**Main category: Production of recycled metals ("secondary" metal production)**	**N**
5.7.1	Production of recycled mercury ("secondary production")	N
5.7.2	Production of recycled ferrous metals (iron and steel)	N
5.7.3	Production of other recycled metals	N
5.8	**Main category: Waste incineration**	**?**
5.8.1	Incineration of municipal/general waste	?
5.8.2	Incineration of hazardous waste	N
5.8.3	Incineration of medical waste	?
5.8.4	Sewage sludge incineration	N
5.8.5	Informal waste burning	?

Cat. no.	Source category	Source presence (y/n/?)
5.9	**Main category: Waste deposition/landfilling and waste water treatment**	**Y**
5.9.1	Controlled landfills/deposits	Y
5.9.2	Diffuse disposal under some control	N
5.9.3	Informal local disposal of industrial production waste	N
5.9.4	Informal dumping of general waste	?
5.9.5	Waste water system/treatment	Y
5.10	**Main category: Crematoria and cemeteries**	**Y**
5.10.1	Crematoria/cremation	Y
5.10.2	Cemeteries	Y

2.1.2 Summary of Estimated Mercury Inputs to Society

Mercury inputs to society should be understood here as the mercury made available for potential releases through economic activity in Jamaica, as estimated in the Toolkit.[9] This includes mercury used in the production phase, including mercury mobilised via extraction and use of raw materials, mercury intentionally used in products such as thermometers, blood pressure gauges, and fluorescent light bulbs, and mercury that can become available through the disposal of these products. These inputs were calculated using input factors present in the Toolkit. Mercury inputs to Jamaica's society by life cycle phase for the source categories identified, as presented in Table 2, are shown below in Table 3.

Table 3: Summary of mercury inputs to society

Toolkit Category Number	Source category	Estimated Hg input, kg Hg/y, by life cycle phase (as relevant)		
		Production phase	Use phase	Disposal phase
5.1	**Main category: Extraction and use of fuels/energy sources**			
5.1.3	Extraction, refining and use of mineral oil	**4.20**	**11.14**	**-**
5.1.4	Extraction, refining and use of natural gas[1]	**-**	**0**	**-**
5.1.6	Biomass fired power and heat production	**-**	**4.56**	**-**
5.2	**Main category: Primary (virgin) metal production**			
5.2.7	Aluminium extraction and initial processing	**3292.30**	**-**	**-**
5.3	**Main category - Production of other minerals and materials with mercury impurities**			
5.3.1	Cement production	**12.76**	**-**	**-**

[9] The factors by which the input was calculated are presented in the Summary of Inputs and Results sub-sections of each source category section in this report.

Toolkit Category	Source category	Estimated Hg input, kg Hg/y, by life cycle phase (as relevant)		
5.3.3	Lime production and light weight aggregate kilns	**8.69**	**-**	**-**
5.5	**Main category: Consumer products with intentional use of mercury**			
5.5.1	Thermometers with mercury[2]	**-**	**64.54**	**27.66**
5.5.2	Electrical and electronic switches, contacts and relays with mercury[2]	**-**	**215.92**	**92.54**
5.5.3	Light sources with mercury[2]	**-**	**19.68**	**13.12**
5.5.4	Batteries containing mercury[2]	**-**	**7.42**	**7.42**
5.5.5	Polyurethane with mercury catalysts[1]	**-**	**0**	**0**
5.5.8	Pharmaceuticals for human and veterinary uses	-	**0**	**-**
5.5.9	Cosmetics and related products[1]	**0**	**0**	**0**
5.6	**Main category: Other intentional products/process uses**			
5.6.1	Dental mercury-amalgam fillings	**62.55**	**59.92**	**55.62**
5.6.2	Manometers and gauges[2]	**-**	**15.37**	**6.59**
5.6.3	Laboratory chemicals and equipment[2]	**-**	**46.12**	**93.64**
5.6.4	Mercury metal use in religious rituals and folklore medicine[1]	**-**	**0**	**0**
5.6.5	Miscellaneous product uses, mercury metal uses and other sources[1]	**0**	**0**	**0**
5.8	**Main category: Waste incineration**			
5.8.1	Incineration of municipal/ general waste[1]	**-**	**-**	**0**
5.8.3	Incineration of medical waste[1]	**-**	**-**	**0**
5.8.5	Informal waste burning[1]	**-**	**-**	**0**
5.9	**Main category: Waste deposition/landfilling and waste water treatment**			
5.9.1	Controlled landfills/deposits	**-**	**-**	**6898.08**
5.9.4	Informal dumping of general waste[1]	**-**	**-**	**0**
5.9.5	Waste water system/treatment	**-**	**-**	**461.03**
5.10	**Main category: Cremation and cemeteries**			
5.10.1	Crematoria	**-**	**12.07**	**-**
5.10.2	Cemeteries	**-**	**37.20**	**-**

1 Identified as possibly being present, however, not enough information to determine the quantity of mercury input to Jamaica.

2 Estimated mercury input by the disposal phase assumed to be equivalent to the calculated output to general waste and sector-specific treatment/disposal for that sub-category.

Note that the following source sub-categories were the largest contributors to mercury inputs to society:

- Aluminium extraction and initial processing (bauxite production)
- Electrical and electronic switches, contacts and relays with mercury
- Dental mercury amalgam fillings

Waste and wastewater produced in the country do not represent original mercury inputs to society (except for imported waste) as the origin of mercury in the waste comes from the mercury in products and materials. Waste deposition to controlled landfills and waste water may represent substantial flows of mercury through society.

2.1.3 Summary of Mercury Releases

The key mercury releases are to air (the atmosphere), water (marine and freshwater bodies, including via waste water systems), land, general waste, and to sector-specific waste treatment and disposal. An additional output pathway is "by-products and impurities" where mercury-containing products and by-products are transferred into the market for consumption. Table 4 provides a more detailed description and definition of the output pathways.

Table 4: Description of the types of output pathways for mercury releases

Calculation result type	Description
Estimated Hg input, kg Hg/y	The standard estimate of the amount of mercury entering this source category with input materials, for example calculated mercury amount in the amount of coal used annually in the country for combustion in large power plants.
Air	Mercury emissions to the atmosphere from point sources and diffuse sources from which mercury may be spread locally or over long distances with air masses; for example, from: • Point sources such as coal-fired power plants, metal smelter, waste incineration; • Diffuse sources as small-scale gold mining, informally burned waste with fluorescent lamps, batteries, thermometers.
Water	Mercury releases to aquatic environments and to waste water systems: Point sources and diffuse sources from which mercury will be spread to marine environments (oceans), and freshwaters (rivers, lakes, etc.). for example, releases from: • Wet flue cleaning systems from coal-fired power plants; • Industry, households, etc. to aquatic environments; • Surface run-off and leachate from mercury-contaminated soil and waste dumps.
Land	Mercury releases to soil; the terrestrial environment: General soil and ground water. For example, releases from: • Solid residues from flue gas cleaning on coal-fired power plants used for gravel road construction; • Uncollected waste products dumped or buried informally; • Local unconfined releases from industry such as on-site hazardous waste storage/burial; • Spreading of sewage sludge with mercury content on agricultural land (sludge used as fertiliser); • Application on land, seeds or seedlings of pesticides with mercury compounds.

Calculation result type	Description
By-products and impurities	By-products that contain mercury, which are sent back into the market and cannot be directly allocated to environmental releases, for example: • Gypsum wallboard produced from solid residues from flue gas cleaning on coal-fired power plants; • Sulphuric acid produced from desulphurisation of flue gas (flue gas cleaning) in non-ferrous metal plants with trace concentrations of mercury; • Chlorine and sodium hydroxide produced with mercury-based chlor-alkali technology; with trace concentrations of mercury; • Metal mercury or calomel as by-product from non-ferrous metal mining (high mercury concentrations).
General waste	General waste: Also called municipal waste in some countries. Typically, household and institution waste where the waste undergoes a general treatment, such as incineration, landfilling or informal dumping or burning. The mercury sources to waste are consumer products with intentional mercury content (batteries, thermometers, fluorescent tubes, etc.) as well as high volume waste like printed paper, plastic, etc., with small trace concentrations of mercury.
Sector specific waste treatment /disposal	Waste from industry and consumers which is collected and treated in separate systems, and in some cases recycled; for example: • Confined deposition of solid residues from flue gas cleaning on coal-fired power plants on dedicated sites; • Hazardous industrial waste with high mercury content which is deposited in dedicated, safe sites; • Hazardous consumer waste with mercury content, mainly separately collected and safely treated batteries, thermometers, mercury switches, lost teeth with amalgam fillings etc.; • Confined deposition of tailings and high-volume rock/waste from extraction of non-ferrous metals. The country-specific waste treatment/disposal method is described for each sub-category in the detailed report sections below.

Table 5 provides a summary of the mercury releases to the various output pathways in Jamaica based on data provided in the Toolkit. Source categories that were not identified as being present in Jamaica are excluded from the table. However, releases from categories that were determined to be potentially present are included and should be updated as more information becomes available. The factors by which the releases were estimated to each pathway are detailed further in the *Summary of Inputs and Results* sub-sections of each of the relevant source category sections of this report.

Table 5: Summary of mercury releases in Jamaica for 2016

Toolkit Category No.	Source category	Calculated Hg output, Kg/y					
		Air	Water	Land	By-products and impurities	General waste	Sector-specific treatment/ disposal
5.1	**Source category: Extraction and use of fuels/energy sources**						
5.1.3	Mineral oils - extraction, refining and use	12.19	0.04	0.00	0.00	0.00	0.63
5.1.4	Natural gas - extraction, refining and use*[1]	0.00	0.00	0.00	0.00	0.00	0.00
5.1.6	Biomass fired power and heat production	4.56	0.00	0.00	0.00	0.00	0.00
5.2	**Source category: Primary (virgin) metal production**						
5.2.7	Aluminium extraction and initial processing	493.85	329.23	0.00	0.00	2140.00	329.23
5.3	**Source category: Production of other minerals and materials with mercury impurities**						
5.3.1	Cement production	7.66	0.00	0.00	2.55	0.00	2.55
5.3.3	Production of lime and light weight aggregates	6.95	0.00	0.00	1.74	0.00	0.00
5.5	**Source category: Consumer products with intentional use of mercury**						
5.5.1	Thermometers with mercury	18.44	27.66	18.44	-	27.66	0.00
5.5.2	Electrical switches and relays with mercury	92.54	0.00	123.38	-	92.54	0.00
5.5.3	Light sources with mercury	9.84	0.00	9.84	-	13.12	0.00
5.5.4	Batteries with mercury	3.71	0.00	3.71	-	7.42	0.00
5.5.5	Polyurethane with mercury catalysts*[1]	0.00	0.00	0.00	-	0.00	0.00
5.5.6	Pharmaceuticals for human and veterinary uses*[1]	0.00	0.00	0.00	-	0.00	0.00
5.5.9	Cosmetics and related products with mercury*[1]	0.00	0.00	0.00	-	0.00	0.00
5.6	**Source category: Other intentional product/process use**						
5.6.1	Dental mercury-amalgam fillings	1.25	25.53	4.45	3.34	11.96	11.96
5.6.2	Manometers and gauges with mercury	4.39	6.59	4.39	0.00	6.59	0.00
5.6.3	Laboratory chemicals and equipment with mercury	0.00	46.12	0.00	0.00	46.12	47.52
5.6.5	Miscellaneous product uses, mercury metal uses, and other sources*[1]	0.00	0.00	0.00	0.00	0.00	0.00

Toolkit Category No.	Source category	Calculated Hg output, Kg/y					
		Air	Water	Land	By-products and impurities	General waste	Sector-specific treatment/ disposal
5.8	**Source category: Waste incineration*[3]**						
5.8.1	Incineration of municipal/general waste*[1]	0.00	0.00	0.00	0.00	0.00	0.00
5.8.3	Incineration of medical waste*[1]	0.00	0.00	0.00	0.00	0.00	0.00
5.8.5	Informal waste burning*[1]	0.00	0.00	0.00	0.00	0.00	0.00
5.9	**Source category: Waste deposition/landfilling and waste water treatment**						
5.9.1	Controlled landfills/deposits*[3]	68.98	0.69	0.00	0.00	0.00	0.00
5.9.4	Informal dumping of general waste*[1*3]	0.00	0.00	0.00	-	-	-
5.9.5	Waste water system/treatment*[2]	0.00	230.52	0.00	0.00	138.31	92.21
5.10	**Source category: Crematoria and cemeteries**						
5.10.1	Crematoria/cremation	12.07	0.00	0.00	-	0.00	0.00
5.10.2	Cemeteries	0.00	0.00	36.20	-	0.00	0.00
SUM OF QUANTIFIED INPUTS AND RELEASES *1*2*3*4		**736.43**	**435.86**	**200.42**	**7.63**	**2483.71**	**484.09**

1 Identified as possibly being present, however, not enough information to determine the quantity of mercury input to Jamaica.

2 The estimated quantities include mercury in products which has also been accounted for under each product category. To avoid double counting, the release to land from informal dumping of general waste has been subtracted automatically in the TOTALS.

3 The estimated release to water include mercury amounts which have also been accounted for under each source category. To avoid double counting release to water from waste water system/treatment have been subtracted automatically in the TOTALS.

4 To avoid double counting of mercury inputs from waste and products in the input TOTAL, only 10% of the mercury input to waste incineration sources, waste deposition and informal dumping is included in the total for mercury inputs. These 10% represent approximately the mercury input to waste from materials which were not quantified individually in the Toolkit.

Overall, once all adjustments were made to account for double-counting of mercury releases through various outputs, the total estimated releases of mercury in 2016 was 4,348.13 kg.

The output pathways to which the highest quantities of mercury were discharged were to general waste (2,483.71 kg Hg/y) and to air (736.43 kg Hg/y).

For general waste, the most significant sector for releases was the bauxite industry with 2,140 kg of mercury released. Further details on this estimation are presented in Section 2.3.1 of this report.

The top three sources of releases to air were estimated to be:

1. Aluminium extraction and initial processing (bauxite production): 493.85 kg Hg/y
2. Use and disposal of consumer products: 124.53 kg Hg/y
3. Controlled landfills/deposits: 68.98 kg Hg/y

2.1.4 Summary of Mercury Stockpiles, and Supply and Trade

Under Article 3 of the Minamata Convention, Parties shall endeavour to identify stocks of mercury or mercury compounds (not including mercury added products) that are in excess of 50 metric tons, as well as sources of mercury supply generating stocks exceeding 10 metric tons per year located within its territory.

At the time of the inventory, it was determined that no such stocks are present in Jamaica.

2.2 Data and Inventory on Energy Consumption and Fuel Production

2.2.1 Refining and Use of Mineral Oils

Refining

Jamaica has one (1) petroleum refinery. The facility uses crude oil in the hydro-skimming process to refine between 32,000 and 36,000 barrels per day (Petrojam, 2017a). The products from the refining process include: liquid petroleum gas (LPG), naphtha, gasoline, kerosene, diesel, heavy fuel oil and residuals such as asphalt, coke, tar and waxes. Between 2015 and 2016, 7,328,068 barrels of crude oil were imported (Petrojam, 2017b). Using the standard US conversion of 7.33 barrels to 1 metric tonne, it was determined that approximately 999,736 metric tonnes of crude oil was imported in that period.

The crude oil is purchased under the San Jose Accord from Venezuela and Mexico, and the Caracas Agreement with Venezuela, in addition to some third-party suppliers. Mercury analysis on crude oil is generally not conducted locally or by suppliers, however, the UN Environment Toolkit Reference Report (2017) gives an average mercury concentration of 4.2 mg Hg/tonne for crude oil extracted from Venezuela based on samples tested from Venezuela's oil fields. This input factor was used, and approximately 4.2 kg Hg was determined to have been produced from refining crude oil in 2016 using the assumption that the quantity of crude oil imported between 2015 and 2016 was equal to the amount that was refined in 2016.

The default output distribution factors given by the UN Environment Toolkit were used. These factors suggested that 25%, 1% and 15% of the total mercury input to society by refining crude oil was released to air, water and sector-specific treatment and disposal, respectively. It should be noted that this leaves approximately 59%, or 2.48 kg, of the mercury input by this source category unaccounted for.

Use

According to the International Energy Agency, approximately 90% of Jamaica's electricity production was derived from oil combustion in 2015. There is only one company in Jamaica responsible for electricity distribution and it has four main power

plants located in Rockfort, and Hunts Bay in Kingston, Old Harbour Bay in St. Catherine, and Bogue in St. James (JPS, 2017). The company has the capacity to generate 693 MW of electricity, in addition to a 197 MW capacity from Independent Power Producers (IPPs). According to the electricity company's 2016 annual report, $306.4 million USD was spent on fuel for electricity in 2016.

Local oil combustion facilities do not have emission controls, and in 2016, an estimated 9.49 kg mercury was released to air from 474,422 tonnes of heavy fuel oil burned. This value was found using a default input factor of 20 mg Hg/tonne oil combusted and is based on the assumption that all the mercury output would be to the atmosphere.

Outside of electricity production, naphtha, and fuel oils are primarily consumed in industry, motor gasoline and gas/diesel are used for transportation, and liquified petroleum gas is used in residents and commercial and public services (International Energy Agency, 2015). Automotive diesel oil is primarily used for transportation in Jamaica, but the analysis certificate from the supplier does not include mercury so the default input factor of 2 mg Hg/ tonne combusted was used when calculating the mercury input from 645,206 tonnes diesel oil used in 2016. The mercury input was determined to be 1.29 kg, and it was assumed that all was released to the atmosphere.

Mercury releases from use of 32,000 tonnes oil for residential heating with no controls and 151,940 tonnes oil in other oil combustion facilities was found to be 0.36 kg when using a default input factor of 2 mg Hg/ tonne oil.

Data Gaps and Priorities for Potential Follow Up

Several gaps in available data were noted, primarily with regards to determining accurate input and output distribution factors.

The priorities to fill identified gaps are to:

- Determine the proportion of crude oil obtained by the petroleum refinery from each supplier;
- Conduct mercury analyses on crude oil samples from each supplier;

- Determine specific output distribution factors for mercury released from refining crude oil in Jamaica; and
- Find specific input factors and output distribution factors for mercury input and released from combustion of oil products in Jamaica.

Summary of Inputs and Results

The Table 6 summarizes the mercury inputs and releases to Jamaica from refining and use of mineral oils during 2016.

Table 6: Analysis of mercury input and output factors for refining and use of mineral oils

Refining and Use of Mineral Oils	Unit	Refining	Use		Sum of releases to pathway from assessed part of life-cycle
			Heavy Fuel Oils	Other Oil Products	
Activity rate	t oil/y	999,736	474,422	829,146	-
Input factor for phase	mg Hg/t oil	4.2	20	2	-
Calculated input to phase	kg Hg/y	4.20	9.49	1.65	-
Output distribution factors for phase:					
- Air	N/A	0.25	1.00	1.00	-
- Water	N/A	0.01	-	-	-
- Land	-	-	-	-	-
- Products	-	-	-	-	-
- General waste treatment	-	-	-	-	-
- Sector-specific waste treatment	N/A	0.15	-	-	-
Calculated outputs/releases to:					
- Air	kg Hg/y	1.05	9.49	1.65	12.19
- Water	kg Hg/y	0.04	-	-	0.04
- Land	-	-	-	-	-
- Products	-	-	-	-	-
- General waste treatment	-	-	-	-	-
- Sector-specific waste treatment	kg Hg/y	0.63	-	-	0.63

2.2.2 Use of Natural Gas

Following the objectives set out in Jamaica's National Energy Policy to reduce the country's dependence on liquid fuels, efforts have been made to diversify the energy sector. In 2016, 80MW of electricity was generated from renewable sources; wind and

solar, through partnerships with several IPPs (JPS, 2017). Imports of liquefied natural gas (LNG) for use in the energy sector also began in 2016.

The local electricity company introduced the use of imported LNG at their 120 MW Power Plant in Bogue, St James, in October 2016. LNG is also expected to be used at a 190 MW Power Plant currently being constructed in Old Harbour Bay, St. Catherine and at a 94 MW Power Plant to be constructed on the grounds of a bauxite facility located in Clarendon.

Data on the LNG used at the Bogue Power Plant was not provided in the electricity company's 2016 report; however, as LNG use only began in the last quarter of 2016 and, as mercury concentrations in consumer supplies of natural gas are generally very low, it is expected that mercury releases for 2016 from this sector would be negligible (COWI, 2002). Further assessments should be done to estimate mercury releases from LNG use in Jamaica once all power plants become operational.

2.2.3 Biomass Fired Power and Heat Production

Charcoal Combustion

Biomass typically burned for power and heat production include wood, including twigs, bark, sawdust and wood shavings, and agriculture residues, including straw, coconut shells and poultry litter. Mercury in these fuel sources originates from natural deposits present in the material, or from the absorption of mercury from anthropogenic emissions over time. Releases to the atmosphere and to residues occur when the material is burned.

While most energy in Jamaica is derived from burning mineral oils and natural gas, and some from coal combustion, it was determined that charcoal combustion to generate heat still occurs in small quantities. In 2016, it was estimated that 38,000 tonnes (dry weight) of charcoal were burned with no emission controls or treatment of residues. Using a default input factor of 0.12 g Hg/tonne charcoal (dry weight) burned, a mercury input of 4.56 kg was determined. It was assumed that all this mercury was released to the air during combustion.

Data Gaps and Priorities for Potential Follow Up

Several gaps in available data were noted. Specific data on the amount, type and mercury concentration of the charcoal used in Jamaica were not found. Residues may have contained mercury; therefore, Hg may have also been released to land and water. Additional information is needed to determine if emission controls or treatment of residues occurred.

The priorities to fill identified gaps are to:

- Conduct a more in-depth analysis of charcoal use in Jamaica to verify the amount, type and mercury concentration of the material burned;
- Determine the mercury concentration of residues from charcoal combustion, and procedures used to dispose residues; and
- Identify emission controls used and the efficiency of the devices.

Summary of Inputs and Results

Table 7 summarizes the mercury inputs and releases to Jamaica from coal combustion in coal fired industrial boilers during 2016.

Table 7: Analysis of mercury input and output factors for charcoal combustion in Jamaica

Charcoal Combustion	Unit	Use	Sum of releases to pathway from assessed part of life-cycle
Activity rate	t charcoal (dry weight)/y	38,000	-
Input factor for phase	g Hg/t charcoal (dry weight)	0.12	-
Calculated input to phase	kg Hg/y	4.56	-
Output distribution factors for phase:			
- Air	N/A	1.0	-
- Water	-	-	-
- Land	-	-	-
- Products	-	-	-
- General waste treatment	-	-	-
- Sector specific waste treatment	-	-	-
Calculated outputs/releases to:			
- Air	kg Hg/y	4.56	4.56
- Water	-	-	-
- Land	-	-	-

Charcoal Combustion	Unit	Use	Sum of releases to pathway from assessed part of life-cycle
- Products	-	-	-
- General waste treatment	-	-	-
- Sector specific waste treatment	-	-	-

2.3 Data and Inventory on Domestic Production of Metals and Raw Materials

2.3.1 Aluminium Extraction and Initial Processing

Alumina Production from Bauxite

Bauxite is an ore of aluminium which is present in Jamaica in the central parishes (Figure 10). Jamaica was once a top global producer of bauxite and exporter of alumina, though no aluminium smelters were built in the country. In the 1970s, Jamaica contributed to 18.1% of the world's global output, but eventually competition from other countries, such as Australia, led to a reduction to about 7.1% of global output by 2008. In 2016, the mining and quarrying sector (bauxite and alumina mainly) contributed 2.2% to Jamaica's GDP (Planning Institute of Jamaica, 2017).

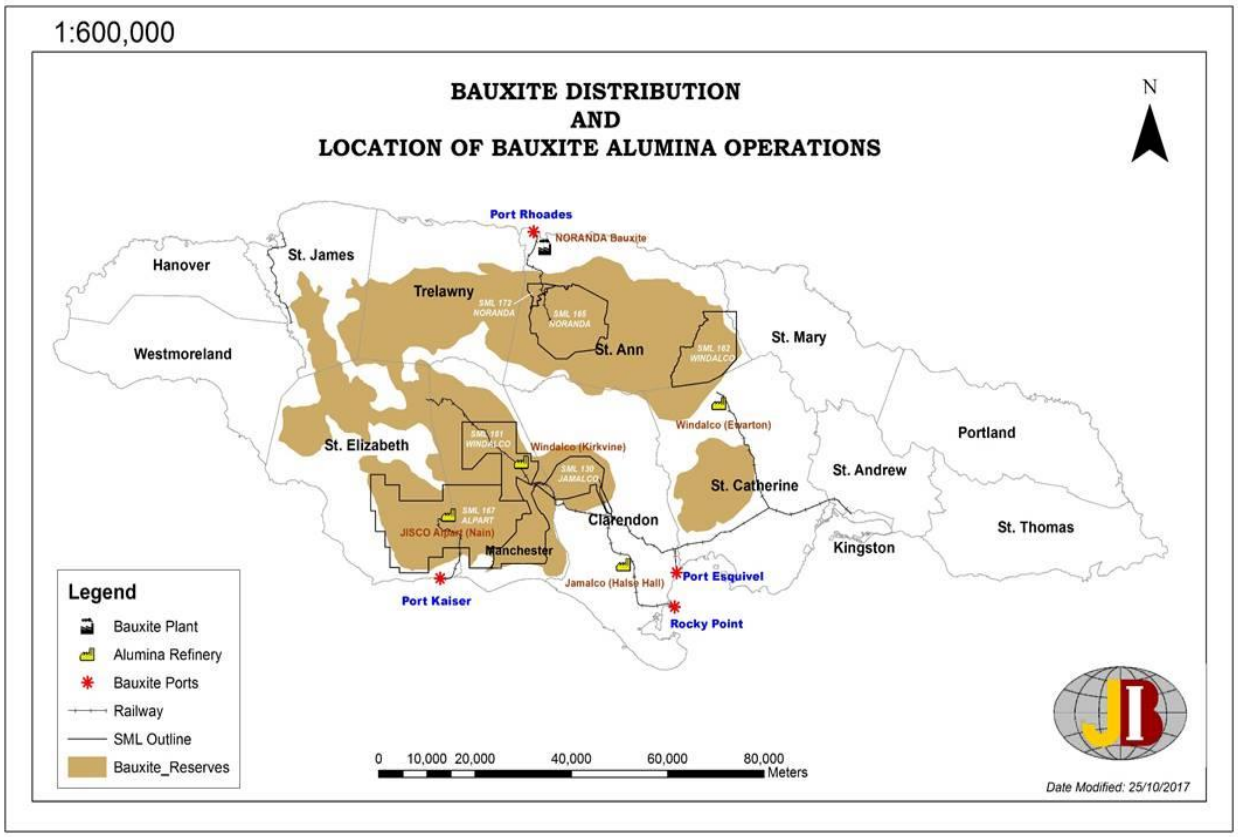

Figure 10: Bauxite-bearing areas in Jamaica

There are three (3) bauxite refining companies in Jamaica, all located in southern parishes.

Data retrieved from the Mines and Geology Division estimates the average quantity of bauxite produced between 2011 and 2015 at 9,698,096 metric tons per year (t/y). The estimated amount of bauxite produced in Jamaica for 2016 was 8,441,794 t/y.

According to a publication by Carlson et al. (2011), mercury concentrations of 500-700 parts per billion (equivalent to 0.5-0.7 grams per tonne) have been found in Jamaican bauxite deposits generally. Figure 11 below shows the location of measured mercury levels in Jamaica's geology. Based on consultations with the Mines and Geology Division, a mercury content in bauxite of 0.39 g/tonne was used in the Toolkit spreadsheet. However, this average value is likely an over-estimation as the national distribution of bauxite with measurable mercury is considerably spatially restricted.

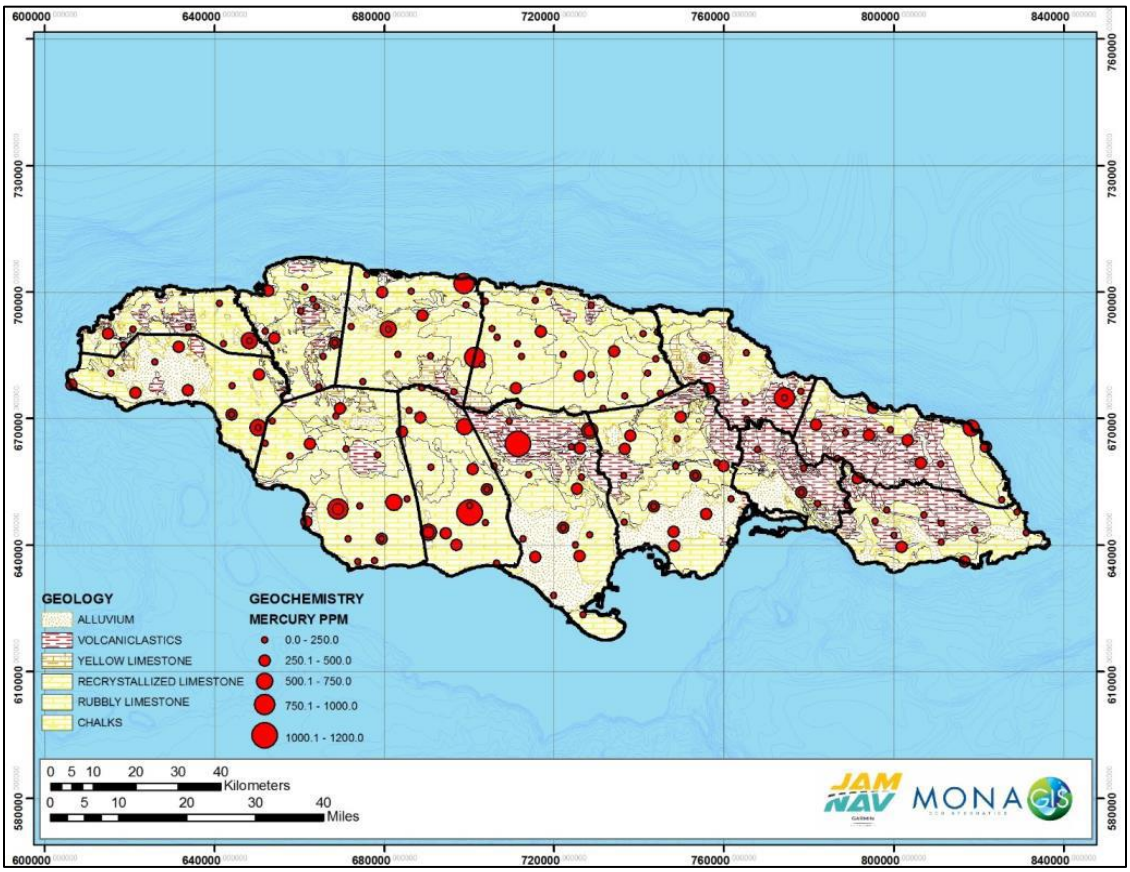

Figure 11: Map showing the geology of Jamaica overlaid with mercury values (Source: Mona Geoinformatics, date unknown)

According to the UN Environment Toolkit, the main pathways of mercury releases from alumina production from bauxite are generally to air, water, general waste and sector-specific treatment and disposal. Air releases may occur if measures are not in place to control the release of mercury-contaminated dusts from mining operations and gaseous emissions from stacks at alumina plants. Bauxite operations that do not have proper disposal of residues, plant effluents, and wastewater result in mercury being released to water. According to the UN Environment Toolkit's assumptions, it is estimated that over 60% of the mercury output from the industry is released to general waste disposed of at landfills.

While it could not be determined at the time of the inventory if mercury releases to air, water and general waste were specifically monitored, it was noted that JBI regulates the industry for all environmental aspects to ensure sound practices.

As mentioned previously, it is generally estimated that over 60% of mercury output from alumina production is released to general waste at landfills. Therefore, the releases estimated for 2016 to general waste for this inventory was estimated to be approximately 2,140 kg of mercury per year. However, in Jamaica, bauxite residues are not disposed of as a part of general waste, but to Residue Disposal Areas (RDAs) or Residue Storage Areas (RSAs). Dry stacking technology is also the preferred method of disposal, rather than wet mud impoundments. The RDAs and RSAs are regulated under the Natural Resources Conservation (Permits and Licences Regulations) 1996.

According to stakeholder consultations, mercury is sometimes observed during the alumina refining process and are collected and stored in containers on-site. One bauxite company indicated that since 2012, mercury from alumina refining operations was collected from condensers in the combustion chamber and stored in appropriate containers. Export of mercury wastes is governed under the Natural Resources (Hazardous Wastes) (Control of Transboundary Movements) Regulations 2002.

Table 8 shows the quantity of mercury amassed annually. This company processes 10,000-12,000 tonnes of bauxite ore per day, which yields about 3600 tonnes of alumina (generally the yield is about 40%). Typically, 1 kg of mercury is collected per week.

Table 8: Elemental mercury collected by one alumina refinery in Jamaica

Year	2016	2015	2014	2013	2012
Mercury collected (kg)	26	21	54	82	100

Based on consultations with JBI, it was concluded that the total mercury releases from bauxite estimated in the Toolkit spreadsheet for 2016 (3,292.3 kg Hg/y) greatly exceeded the actual releases estimated for this sector. This is mainly due to the factor used in the Toolkit of 0.65 to calculate releases to general waste. Current containment and disposal methods would suggest that this factor is less than 0.65. Releases to air, water, and sector-specific treatment/disposal also require more in-depth analysis to determine accuracy. It is also important to note that mercury content in bauxite varies amongst the different mining sites. The bauxite company that collected mercury as shown in Table 8, has mining operations in an area where the mercury content is notably higher than other locations. Further research is necessary to determine the estimated releases of mercury from the bauxite sector.

Data Gaps and Priorities for Potential Follow Up

Several gaps in available data were noted. The output distribution factors used in the Toolkit did not take into consideration the environmental regulations in place locally for managing pollution from the bauxite industry. As such, there may have been over-estimations for mercury releases from the sector. The calculated mercury output to general waste disposed at landfills is most likely higher than the actual value, and the releases via sector specific treatment and disposal is expected to be less than the quantity estimated by the Toolkit. Further, since mercury content in bauxite varies throughout the country, the input factor used may not fully represent the national mercury input to Jamaica by the bauxite industry.

The priorities to fill identified gaps are to:

- Assess mercury containment and disposal procedures in the bauxite industry in Jamaica to determine accurate output distribution factors;

- Endeavour to determine mercury concentrations in bauxite mined at various sites and calculate mercury input based on characteristics of material mined from each site.

Summary of Inputs and Results

Table 9 summarizes the mercury inputs and releases to Jamaica from alumina production from bauxite during 2016.

Table 9: Analysis of mercury input and output factors for alumina production from bauxite

Aluminium Extraction and Initial Processing	**Unit**	**Production**	**Sum of releases to pathway from assessed part of life-cycle**
Activity rate	t bauxite/y	8,441,794	-
Input factor for phase	g Hg/t bauxite	0.39	-
Calculated input to phase	kg Hg/y	3,292.30	-
Output distribution factors for phase:			
- Air	N/A	0.15	-
- Water	N/A	0.10	-
- Land	-	-	-
- Products	-	-	-
- General waste treatment	N/A	0.65	-
- Sector-specific waste treatment	N/A	0.10	-
Calculated outputs/releases to:			
- Air	kg Hg/y	493.85	493.85
- Water	kg Hg/y	329.23	329.23
- Land	-	-	-
- Products	-	-	-
- General waste treatment	kg Hg/y	2,140.00	2,140.00
- Sector-specific waste treatment	kg Hg/y	329.23	329.23

2.4 Data and Inventory on Production of Minerals and Materials with Mercury Impurities

Raw materials such as lime, coal, clay, and wood, which are used to produce cement, pulp and paper, and lime and light weight aggregates, can contain trace amounts of mercury. During various mechanical, chemical and thermal processes, this mercury can be released to the environment.

2.4.1 Cement Production

Mercury releases in cement production generally occur during the clinker manufacturing stage and are due to the natural occurrence of mercury in quarried raw materials used as feedstock and in fuels used in the cement kilns. Crushed and ground limestone, clay and gypsum can release mercury-contaminated dust particles to the atmosphere. Emissions from sintering/burning the crushed material can also release mercury if effective emission controls are not implemented (Gossman, 2007). Cement clinker production facilities are therefore listed in Annex D of the Minamata Convention on Mercury, as point sources of emissions of mercury and mercury compounds to the atmosphere and, are subject to the obligations listed in Article 8 of the Convention concerning the management of emissions.

Figure 12 further illustrates how mercury is cycled in a modern cement plant, which shows that the main release of mercury is through the emission stacks. Existing mercury abatement methods include the use of scrubbers in the emission stacks to reduce the amount of mercury released into the environment.

Jamaica's sole cement manufacturer is in Rockfort, Kingston, and has been in operation in Jamaica since 1952 (Figure 13). Cement from this company is used locally and exported primarily to Suriname and Haiti. According to the company's annual report for the year 2016, operations produced 761,061 tonnes of clinker and 911,325 tonnes cement. The weight of cement produced was used in the Toolkit to calculate mercury releases from this sector. It is important to note that calculations were based on the assumption that all clinker formed was accounted for in cement production. It should be noted that the cement company's report specified that 39,540 tonnes of clinker were exported to Barbados and Venezuela, and emissions from this fraction of clinker production should be considered in further calculations.

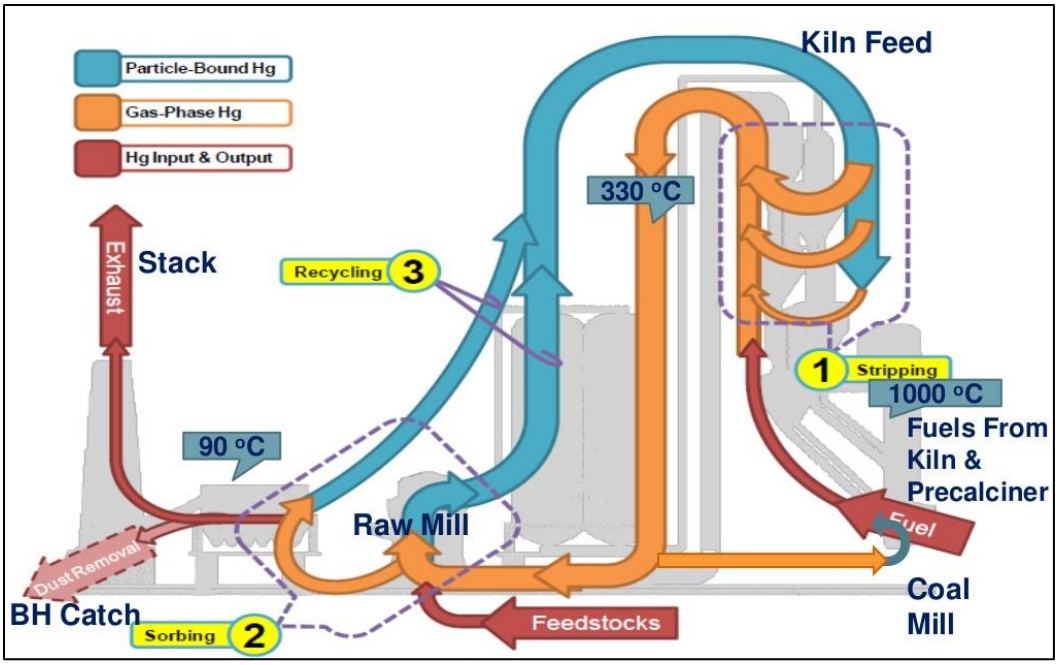

Figure 12: Mercury cycle in a modern cement plant

(Source: ZKG International, 2015)

In the cement sector in Jamaica, limestone and gypsum are used as raw materials while coal or petcoke with the co-incineration of waste are used as sources of fuel in the cement kilns. It is estimated that much of the total mercury output from the cement industry is released to the air during the combustion of fuel in the cement kiln.

The plant can only consume coal or petcoke blended with coal, and the annual consumption of coal used by the facility was projected to be between 110,000 and 130,000 metric tonnes according to stakeholder consultations. Actual tonnage consumed throughout the year would vary based on the quality of the fuel received and the actual tonnes of clinker produced. A new coal mill was installed between 2016 to 2017 to supplement the low production rate of the current underperforming facility (CCCL, 2016).

The cement company's operations in Jamaica include the monitoring of mercury emissions from their emission stacks. During stakeholder consultations with the cement company, it was noted that emissions of mercury to the air in 2016 were only observed from one kiln (Kiln #5) which was estimated to have released 8.71 kg Hg/y. This was

determined by the company by using the mercury emissions factor for kiln #5 from AP42, a compilation of air emission factors published by the United States Environmental Protection Agency (US EPA) and accepted under the local National Ambient Air Quality Standards Regulations; and the mass per tonne of clinker produced in 2016. As the capacity of this kiln was increased from 2,000 tonnes/day to 2,800 tonnes/day in August 2016, emissions should continue to be monitored.



Figure 13: Cement production facility in Jamaica
(Source: Civil, Environmental and Coastal (CEAC) Solutions, 2016)

In the Toolkit spreadsheet, the mercury input to society by cement production in Jamaica was determined to be 12.76 kg Hg in 2016. This value was calculated using the default factor provided in the Toolkit of 0.014 g Hg/ t cement produced based on the assumption that the primary fuel source was hard coal. The air emissions from kiln #5 are controlled by fabric filters, but there is no specific mercury pollution control on the unit. As such, approximately 7.66 kg mercury was expected to have been released to the air from this source in 2016. Mercury output to cement products and sector specific treatment and disposal were calculated as 2.55 kg each.

The total releases of mercury estimated by the cement company through their analysis (8.71 kg Hg/y) are comparable to the calculated air emissions determined by the Toolkit spreadsheet (7.66 kg Hg/y).

Data Gaps and Priorities for Potential Follow Up

Several gaps in available data were noted. As no data was available to determine the amount of petcoke used for fuel or how often co-incineration of waste occurs, assumptions were made that hard coal was the main fuel used for cement production. The disposal methods for the mercury-contaminated waste produced were not determined. Further research should be conducted to assess these gaps.

Summary of Inputs and Results

Table 10 summarises the mercury inputs and releases to Jamaica from cement production during 2016.

Table 10: Analysis of mercury input and output factors for cement production

Cement Production	Unit	Production	Sum of releases to pathway from assessed part of life-cycle
Activity rate	t cement/y	911,325	-
Input factor for phase	g Hg/t cement	0.014	-
Calculated input to phase	kg Hg/y	12.76	-
Output distribution factors for phase:			
- Air	N/A	0.6	-
- Water	-	-	-
- Land	-	-	-
- Products	N/A	0.2	-
- General waste treatment	-	-	-
- Sector-specific waste treatment	N/A	0.2	-
Calculated outputs/releases to:			
- Air	kg Hg/y	7.66	7.66
- Water	-	-	-
- Land	-	-	-
- Products	kg Hg/y	2.55	2.55
- General waste treatment	-	-	-
- Sector-specific waste treatment	kg Hg/y	2.55	2.55

2.4.2 Lime Production

Lime is produced from the calcination of limestone, which is a process that involves the combustion of calcium carbonate at high temperatures. Mercury, typically naturally present in limestone deposits, may be released to the environment (mainly air) during this combustion process. The type of fuel used for combustion can also contribute to mercury releases, depending on the fuel's mercury content. Trace amounts of mercury may also be released in the by-products or impurities produced during the process. No analyses conducted have shown mercury in limestone in Jamaica at any appreciable levels.

Jamaica has significant reserves of limestone as approximately 70% of the island's surface coverage is comprised of limestone. Three grades of limestone are present in Jamaica: pharmaceutical, chemical and metallurgical; the latter is used primarily in the bauxite industry (Jamaica Gleaner, 2013). The lower quality grades of limestone are also used as fill in construction. Although certain limestone reserves found in Jamaica were deemed to be of very high quality, limestone production has historically been very small and has fluctuated over the years (Meditz and Hanratty, 1987). According to the Transport Ministry, emphasis is being placed on exploring opportunities to increase lime production in the coming years (Jamaica Observer, 2017). Therefore, mercury releases estimated from this sector may increase in the future.

Using the default input factor of 0.06 g Hg per tonne of lime produced, an estimated mercury release of 8.69 kg Hg was calculated for 2016. Mercury emitted to air was found to be approximately 6.95 kg while output in products was 1.74 kg.

Data Gaps and Potential Follow Up

The mercury concentration in the raw material used is unknown, and actual output distributions were not determined. Mercury controls in production facilities were not mentioned. It should also be noted that projected increases in lime production in Jamaica may significantly increase future mercury emissions, and this source should be continuously monitored to avoid these releases.

The priorities to fill identified gaps are to:

- Verify the concentration of mercury in raw materials used;
- Determine actual output distribution factors; and
- Identify whether mercury controls are used.

Summary of Inputs and Results

Table 11 summarises the mercury inputs and releases to Jamaica from lime production during 2016.

Table 11: Analysis of mercury input and output factors for lime production

Lime Production	Unit	Production	Sum of releases to pathway from assessed part of life-cycle
Activity rate	t lime/y	144,836	-
Input factor for phase	g Hg/t lime	0.06	-
Calculated input to phase	kg Hg/y	8.69	-
Output distribution factors for phase:			
- Air	N/A	0.8	-
- Water	-	-	-
- Land	-	-	-
- Products	N/A	0.2	-
- General waste treatment	-	-	-
- Sector-specific waste treatment	-	-	-
Calculated outputs/releases to:			
- Air	kg Hg/y	6.95	6.95
- Water	-	-	-
- Land	-	-	-
- Products	kg Hg/y	1.74	1.74
- General waste treatment	-	-	-
- Sector-specific waste treatment	-	-	-

2.5 Data and inventory on consumer products with intentional use of mercury

The intentional use of mercury in certain products can result in mercury releases during the manufacture, use, and end-of-life disposal of these items. Reducing and eventually eliminating the use of consumer products containing mercury that can be released throughout their life-cycle is a priority area for Jamaica to successfully implement the Minamata Convention on Mercury. Under the Convention, Parties must phase-out, by 2020, the manufacture, import and export of specific mercury-added products listed under Annex A, Part I. These products include electrical switches and relays, batteries, lighting devices, medical devices and cosmetics. Details on the types of products and their exemptions are also listed in the Annex. Annex A, Part II provides phase-down measures for dental amalgam.

2.5.1 Thermometers Containing Mercury

Historically, mercury has been used in thermometers because of its low vapour pressure which makes it ideal for detecting small changes in temperature and facilitates measurements within a large range of temperatures. Different types of mercury thermometers have been used for medical applications, ambient air temperature monitoring, laboratory or educational purposes, or industrial uses and special applications, such as for the control of large diesel engines in ships.

Thermometers containing mercury are not produced in Jamaica. However, mercury-containing medical and ambient air thermometers are predominantly used in Jamaica's hospitals and public healthcare facilities (Palmer, 2016). Secondary and tertiary institutions, laboratories, and households may also use mercury-added thermometers. In 2016, data from the Statistical Institute of Jamaica showed that 26,345 mercury-containing thermometers were imported into Jamaica, however, this data does not distinguish between the types of mercury thermometers imported. Therefore, data for medical thermometers containing mercury was not able to be specified and it was assumed that all the thermometers used were mercury-containing ambient air thermometers.

Mercury spills from broken thermometers and other mercury containing medical devices are not adequately managed in Jamaica's hospitals, where appropriate containers for storage are not available, testing of ambient mercury concentrations is not conducted, and proper storage and disposal procedures are not in place. Mercury-free alternatives are perceived to be of lower quality with less accuracy, thus promoting the continued use of mercury-containing instruments.

Data was not received on the disposal methods used for discarding end-of-life mercury thermometers; however, feedback from members of the medical industry led to the assumption that some controlled and informal waste handling occurred. While thermometers were not collected separately, if disposed of with biohazardous wastes, it would be treated as such at medical waste incineration facilities and at the landfill sites where hazardous waste is currently stored in a separate shed. Since this information was not obtained, the releases to output pathways were estimated based on the default factors included in the Toolkit.

Overall, it was calculated that 92.21 kg of mercury was input to Jamaica's society by the use and disposal of thermometers in 2016. Mercury waste from thermometers is output to air, water, land, and general waste. Mercury vapour from broken thermometers and emissions from incineration of thermometers disposed of as biohazardous waste, account for the output to air which was estimated to be 18.44 kg in 2016. In the PAHO/WHO 2016 Workshop, it was indicated that healthcare workers often wash mercury wastes from broken equipment in general-purpose sinks which are connected to general wastewater streams, thus leading to contamination of waterways with approximately 27.66 kg of mercury being released during the studied year. Since measures are not in place for proper treatment and disposal of mercury wastes in Jamaica, a significant portion of mercury output is to general waste. This quantity was calculated to be 27.66 kg. Some mercury contaminated medical wastes are not separated from the general waste stream and are therefore dumped in the landfills, contributing to approximately 18.44 kg of mercury releases to land.

Data Gaps and Potential Follow Up

Several gaps in available data were noted which may have resulted in overestimated mercury input quantities by this source. Firstly, the information obtained from the Statistical Institute of Jamaica did not specify the type of thermometer imported into the country, therefore, the assumption was made that all the thermometers used were ambient air thermometers. The mercury content in ambient air thermometers is higher than the corresponding value for medical thermometers, and this assumption may have contributed to a significant increase in the calculated values. Further, the disposal methods used for thermometers by workers in the medical field were not determined, and the default factors used may not fully represent the mercury releases by this source.

The priorities to fill identified gaps are to:

- Determine the ratio of medical and ambient air thermometers used through household and healthcare questionnaires, and extrapolate the mercury input using the information obtained;
- Determine the quantities of end-of-life thermometers being disposed of, and the methods of disposal used; and
- Estimate the proportion of controlled and informal waste handling occurring.

Summary of Inputs and Results

Table 12 summarises the mercury inputs and releases to Jamaica from the use and disposal of mercury containing thermometers during 2016.

Table 12: Analysis of mercury input and output factors for imported mercury thermometers

Use and Disposal of Thermometers with Mercury	Unit	Use and Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	items/y	26,345	-
Input factor for phase	g Hg/item	3.5	-
Calculated input to phase	kg Hg/y	92.21	-
Output distribution factors for phase:			
- Air	N/A	0.2	-
- Water	N/A	0.3	-

Use and Disposal of Thermometers with Mercury	Unit	Use and Disposal	Sum of releases to pathway from assessed part of life-cycle
- Land	N/A	0.2	-
- Products	-	-	-
- General waste treatment	N/A	0.3	-
- Sector-specific waste treatment	-	-	-
Calculated outputs/releases to:			
- Air	kg Hg/y	18.44	18.44
- Water	kg Hg/y	27.66	27.66
- Land	kg Hg/y	18.44	18.44
- Products	-	-	-
- General waste treatment	kg Hg/y	27.66	27.66
- Sector-specific waste treatment	-	-	-

2.5.2 Electrical Switches and Relays Containing Mercury

Elemental mercury was a commonly used component of electrical switches and relays found in numerous electrical apparatus, but in the last two decades, mercury-free switches and relays have become more popular globally. Due to the long service life of most switches and relays, however, mercury-containing end-of-life electrical switches and relays are still expected to be present in waste for many years (UN Environment, 2017a).

The most common use of elemental mercury in the manufacture of electrical equipment is in tilt switches or “silent” switches, which are used for silent electric wall switches, convenience lights (such as those used in car trunks when it is opened), Antilock Braking Systems and active ride-control systems in vehicles, as well as thermostats for air conditioning and ventilation units.

Relays, which are electrically controlled switches, also use mercury as a component. Some mercury-containing relays include mercury-displacement relays, mercury-wetted reed relays, and mercury-contact relays. Although the mercury relays may be widely used, the total mercury consumption with relays of electronics has been relatively small compared to the mercury switches.

Due to switches and relays being components of larger products that are imported into the country, the number used and the presence of mercury as a component could not

be specifically determined. Therefore, the estimation for mercury releases from electrical switches and relays in the Toolkit was determined by using default calculations provided that were based on electrification rates and population data for Jamaica from 1996, and a default mercury input concentration. Population data and electrification rates from 1996 were used to give a more accurate estimation of historical consumption to estimate the current mercury output from end-of-life switches and relays. Due to the long life-span of switches and relays, it has been assumed that the electrification rate and population data for 1996 would be able to give an estimation of the mercury that may be released from the disposal of the switches and relays at the end of their life span approximately twenty (20) years later in 2016.

While mercury-added electrical switches and relays are in use, mercury is not released as it is contained within sealed glass bulbs within the devices; however, mercury may be released if the devices are broken and disposed of. It was also noted that switches and relays are not separately collected, and only informal waste handling, occurred.

The inventory showed that 308.46 kg of mercury was released to air, land and general waste due to the use and disposal of mercury-containing electrical relays and switches in Jamaica. The estimated releases from these products for 2016 was calculated based on a 1996 population of 2,561,993 inhabitants, 1996 electrification rate of 86% (World Bank), and an input factor of 0.14 g Hg/(y*inhabitant). The most significant output of mercury was estimated to be to the land, 123.38 kg, where releases were expected to have occurred from dumping of equipment containing electrical switches and relays, and through spillage of mercury during informal handling.

Data Gaps and Potential Follow Up

The main data gap for this source category was a lack of specific information on the quantity of electrical switches and relays used and the ratio of mercury distribution to the various output pathways. While the use of mercury-containing electrical switches and relays has significantly declined, specific data on the historic use should be gathered, monitoring of quantities of end-of-life switches and relays and disposal methods should occur, and information should be collected on the current import rates of such items.

Summary of Inputs and Results

Table 13 summarises the mercury inputs and releases to Jamaica from the use and disposal of mercury-containing electrical switches and relays during 2016.

Table 13: Analysis of mercury input and output factors for electrical switches and relays

Use and Disposal of Electrical Switches and Relays with Mercury	Unit	Use and Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	inhabitants	2,561,993	-
Input factor for phase	g Hg/(y*inhabitant)	0.14	-
Calculated input to phase	kg Hg/y	308.46	-
Output distribution factors for phase:			
- Air	N/A	0.3	-
- Water	-	-	-
- Land	N/A	0.4	-
- Products	-	-	-
- General waste treatment	N/A	0.3	-
- Sector-specific waste treatment	-	-	-
Calculated outputs/releases to:			
- Air	kg Hg/y	92.54	92.54
- Water	-	-	-
- Land	kg Hg/y	123.38	123.38
- Products	-	-	-
- General waste treatment	kg Hg/y	92.54	92.54
- Sector-specific waste treatment	-	-	-

2.5.3 Light Sources with Mercury

Mercury is used as a multiphoton source in bulbs as it produces ultra violet light when an electric current is passed through a tube. Eventually, the light loses its efficiency as mercury in the tube reacts with phosphorus powder which coats the inside surface of the tube. The lifespan of these lighting devices varies between five (5) to ten (10) years.

Various types of discharge lamps used today are produced using mercury, including compact fluorescent lamps (CFLs), linear fluorescent lamps (LFLs) and high-pressure mercury-vapour lamps (HPMV), used for general lighting purposes for commercial and municipal applications, and cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL), which are used in electronics. Other light sources

that may contain mercury include special lamps for photographic purposes, atomic absorption spectrometry lamps, and ultraviolet sterilisation (UN Environment, 2017a).

CFLs, which contain about four milligrams of mercury (US EPA, 2017), and other mercury-bearing lights have become more frequently used globally because of their energy-saving capabilities and longer life-span. While intact, these bulbs do not release mercury, however, if broken, contamination can occur.

Lighting devices are not manufactured in Jamaica but are imported for use.

In 2006 and 2013, there was a drive to replace incandescent bulbs with energy saving CFLs under the Jamaica/Cuba Bulb Project. The initial project saw the distribution of 2,841,628 CFLs to residents in addition to 331,172 unaccounted CFLs that had been shipped from Cuba (Strachan, 2007). While being more energy efficient than the previously used incandescent bulbs, the Bureau of Standards Jamaica reported that the imported CFLs were of sub-standard quality with a shorter life-span than available alternatives (Sustainable Development and Regional Planning Division: Planning Institute of Jamaica, 2007). As such, the imported bulbs would need to be replaced in less time than better alternatives, thus generating significant amounts of mercury wastes.

A bulb eater machine (Figure 14) located at the University of the West Indies (UWI), Mona Campus was instrumental in destroying approximately 9,000 spent bulbs that had been distributed during the Jamaica/Cuba Bulb project.



Figure 14: UWI, Mona bulb eater (Photo credits: April Johnson, 2017)

It was noted that in April 2017, there was an estimated 570 g Hg waste from the bulb eater in storage at the campus facility (Figure 15). This mercury waste was generated through filtering of contaminated air, powder and mercury vapour from crushed fluorescent tubes using a three-stage process. First, a filter captures over 99% of released dust particulates. Another filter further retains 99.99% of the remaining particulates before passing the contaminated vapour through an activated carbon filter, which adsorbs the residual mercury vapour.

Double ended linear fluorescent lamps (LFLs), which contain up to 25 mg of mercury, are also used in organizations such as schools, churches, hospitals, government buildings and other municipal and private structures throughout Jamaica. According to discussions held with stakeholders at the national inception workshop for the Minamata Initial Assessment project, it was deduced that, most of the spent fluorescent tubes are disposed in the local trash and are therefore deposited in the landfills as general waste.



Figure 15: Bulb waste after removal of mercury
(Photo credits: April Johnson, 2017)

Import data from Customs showed that 1,287,226 fluorescent tubes, and 24,786 metal halide lamps were brought into the country in 2016. This data did not distinguish between double ended LFLs and CFLs, and it also did not specify if the imported bulbs all contained mercury. It was assumed that all the tubes contained mercury, and that the total value recorded for fluorescent tubes was representative of linear tubes. This assumption resulted in a total calculated mercury input of 32.18 kg for fluorescent tubes with a default input factor of 25 mg Hg per tube. Metal halide lamps were estimated to be responsible for 0.62 kg of mercury input to Jamaica in 2016.

The mercury output to air, land and general waste was calculated using default factors which assumed that no separate collection occurred and that there was informal handling. Output to air occurs when mercury vapor is released from broken tubes. Since there was no recorded sector-specific treatment and disposal, it was estimated that mercury from broken and end-of-life tubes was released to land through dumping and informal waste handling or discarded with general waste.

Information on imported CFLs, HPMVs, high-pressure sodium lamps and UV lights for tanning was unavailable and should be sourced in a follow-up inventory.

Data Gaps and Potential Follow Up

Several gaps in available data were noted. The information obtained from Customs did not differentiate between the fluorescent tubes imported into the country, therefore, assumptions were made that all the bulbs used contained mercury and were linear fluorescent lamps (LFLs). The mercury content in LFLs is higher than the corresponding value for CFLs, and this assumption may have contributed to a significant increase in the calculated values. The output distribution factors were not specific to Jamaica, and pathways such as water and sector-specific treatment and disposal were not included. Information is needed on the quantities of other light sources used in Jamaica.

The priorities to fill identified gaps are to:

- Determine the ratio of mercury-containing CFLs and LFLs imported and used to extrapolate the mercury input using the information obtained;
- Determine the quantities of end-of-life mercury-containing light sources being disposed of, and the methods of disposal used; and
- Estimate the specific output distribution factors for use and disposal of mercury-containing light sources in Jamaica.

Summary of Inputs and Results

Table 14 summarises the mercury inputs and releases to Jamaica from the use and disposal of mercury-containing light sources during 2016.

Table 14: Analysis of mercury input and output factors for imported Hg containing light sources

Use and Disposal of Light Sources with Mercury	Unit	Use and Disposal		Sum of releases to pathway from assessed part of life-cycle
		Fluorescent Tubes	Metal Halide Lamps	
Activity rate	items/y	1,287,226	24,786	-
Input factor for phase	mg Hg/item	25	25	-
Calculated input to phase	kg Hg/y	32.18	0.62	-
Output distribution factors for phase:				
- Air	N/A	0.3	0.3	-
- Water	-	-	-	-
- Land	N/A	0.3	0.3	-
- Products	-	-	-	-

Use and Disposal of Light Sources with Mercury	Unit	Use and Disposal		Sum of releases to pathway from assessed part of life-cycle
		Fluorescent Tubes	Metal Halide Lamps	
- General waste treatment	N/A	0.4	0.4	-
- Sector-specific waste treatment	-	-	-	-
Calculated outputs/releases to:				
- Air	kg Hg/y	9.65	0.19	9.84
- Water	-	-	-	-
- Land	kg Hg/y	9.65	0.19	9.84
- Products	-	-	-	-
- General waste treatment	kg Hg/y	12.87	0.25	13.12
- Sector-specific waste treatment	-	-	-	-

2.5.4 Batteries with Mercury

Mercury is a very effective suppressor of zinc corrosion, which ultimately prevents the build-up of hydrogen, a potentially explosive gas, in various types of batteries. It is also used in high concentrations as a positive electrode in mercury-oxide batteries which are also called zinc-mercury batteries (UN Environment, 2017a). Batteries are among the largest product uses of mercury globally.

Prior to 1997, mercury-oxide batteries were found in motorised equipment, hearing aids, watches, calculators, computers, smoke detectors, tape recorders, regulated power supplies, scientific equipment, pagers, and portable electrocardiogram monitors. Over the years, developed countries have banned or limited the use of mercury in batteries and are now manufacturing batteries without intentionally added mercury content. However, mercury is still used in some button-cell shaped batteries of alkaline, silver oxide and zinc/air types that can be found in hearing aids, electronics, small toys and watches.

Jamaica imports a wide variety of mercury-containing batteries including mercury oxide batteries of varying sizes, zinc-air button cells, alkaline button cells, and silver oxide button cells. Data from the Statistical Institute of Jamaica estimates the total weight of batteries imported at 1.316 tonnes for 2016. Default input factors were used to calculate a total mercury input of 14.84 kg by batteries used and disposed of in Jamaica.

Mercury from batteries can escape into the environment after they have been disposed of in landfills. The main mercury release pathways for batteries are through the atmosphere, land and general waste (UN Environment, 2017a).

Data Gaps and Potential Follow Up

Assumptions were made regarding the number of units imported because the data obtained from the Statistical Institute of Jamaica was given as an estimated value in currency of the batteries imported as well as the number of items imported. Due to batteries being components of larger products that are imported into the country, the actual number of batteries imported was not fully captured by the data used. Further, the input and output distribution factors used were default values given in the Toolkit Spreadsheet and are not specific to Jamaica.

The priorities to fill identified gaps are to:

- Obtain data on the actual weight of batteries imported into the country;
- Estimate quantity of mercury-containing batteries imported as components of electrical and electronic equipment; and
- Estimate the specific input and output distribution factors for the use and disposal of mercury-containing batteries in Jamaica.

Summary of Inputs and Results

Table 15 summarises the mercury inputs and releases to Jamaica from the use and disposal of mercury-containing batteries during 2016.

Table 15: Analysis of mercury input and output factors for imported Hg containing batteries

Use and Disposal of Batteries with Mercury	Unit	Use and Disposal				Sum of releases to pathway from assessed part of life-cycle
		Mercury Oxide	Zinc Air	Alkaline	Silver Oxide	
Activity rate	t batteries/y	0.015	0.530	0.598	0.173	-
Input factor for phase	kg Hg/t batteries	320	12	5	4	-
Calculated input to phase	kg Hg/y	4.80	6.36	2.99	0.69	-
Output distribution factors for phase:						
- Air	N/A	0.25	0.25	0.25	0.25	-
- Water	-	-	-	-	-	-

Use and Disposal of Batteries with Mercury	Unit	Use and Disposal				Sum of releases to pathway from assessed part of life-cycle
		Mercury Oxide	Zinc Air	Alkaline	Silver Oxide	
- Land	N/A	0.25	0.25	0.25	0.25	-
- Products	-	-	-	-	-	-
- General waste treatment	N/A	0.50	0.50	0.50	0.50	-
- Sector-specific waste treatment	-	-	-	-	-	-
Calculated outputs/releases to:						
- Air	kg Hg/y	1.20	1.59	0.75	0.17	3.71
- Water	-	-	-	-	-	-
- Land	kg Hg/y	1.20	1.59	0.75	0.17	3.71
- Products	-	-	-	-	-	-
- General waste treatment	kg Hg/y	2.40	3.18	1.50	0.35	7.42
- Sector-specific waste treatment	-	-	-	-	-	-

2.5.5 Polyurethane with Mercury Catalysts

Polyurethane is used in the manufacture of products including high resilience foam seating, high performance adhesives, surface coating and sealants, synthetic fibres, and durable wheels for products, such as shopping carts, escalators and elevators. The production of polyurethane materials may involve the use of organic mercury compounds as catalysts to harden or cure the polyurethane (PU) materials. The catalyst may become embedded in the structure of the compound and remain in the final product where it may be released to the environment during use or disposal.

Polyurethane is used by few entities in Jamaica. Mixtures of PU are used by a paint company in Jamaica as a protective and marine coating, though it was not confirmed whether mercury catalysts were used in the production of those mixtures. The use of mercury and the prevalence of polyurethane in Jamaica could not be determined at the time of this inventory but should be investigated in future research for mercury management.

2.5.6 Pharmaceuticals for Human and Veterinary Uses

Mercury has been used in various pharmaceuticals such as vaccines, eye drops, herbal medicines and other products, mainly due to its function as a preservative. While the use of mercury in pharmaceuticals has decreased significantly in recent years, it may

still be present in some products. For example, mercurochrome is still used as a key ingredient in antiseptics being sold in some pharmacies in Jamaica. Mercury in pharmaceuticals may be released through the body to wastewater, which can enter oceans directly and bio-magnify up the food chain in aquatic species.

The prevalence of mercury in pharmaceuticals for human and veterinary purposes in Jamaica could not be confirmed at the time of the inventory but should be noted for future consideration in the management of mercury releases.

2.5.7 Cosmetics and Related Products with Mercury (Skin-lightening Cosmetics)

Skin bleaching involves the use of products such as creams, soaps, injections and home-made products to depigment skin. Depigmentation is a procedure by which the melanin produced in the skin is reduced, resulting in lightened skin (Mohammed, et al., 2017). Inorganic mercury is an effective suppresser of melanin production and is therefore, found in skin-lightening products identified on the global market (Boischio, 2017).

The use of skin lightening creams has been found to be prevalent around the globe especially in African and Asian countries and Afro-diaspora regions like the Caribbean (Hamann, et al., 2014; Copan et al., 2015). In Jamaica, the use of skin lightening products by some members of society has been found to be promoted through advertisements, marketing strategies, and popular culture influencers aimed particularly at African-Jamaican women (Edmond, 2014). Its use has been attributed to longstanding colour complex issues traced back to stigmas generated during colonialization (Lewis et al., 2011). Further discussions on the social issues associated with skin lightening creams and the recommendations to address them are noted in Chapters 4, 5 and 6 of this report.

It was noted that some skin-lightening creams on the local market contain other melanin suppressors such as hydroquinone rather than mercury; however, more testing of the products being sold should be done to accurately determine this. Generally, while certain products list mercury as an ingredient, many are unlabelled, mislabelled, counterfeit, or labelled in a foreign language, so the risk of using any of these products

is increased as consumers are not able to identify their components (Zero Mercury Working Group, 2010). The identification of the number of skin lightening creams imported into Jamaica could not be quantified for this inventory. Lewis et al. (2011) also noted that many of these creams have been found to be sold on the black market which indicates that they would likely not be able to be accounted for by Customs officials.

The manufacture and export of skin lightening creams does occur in Jamaica. Information from manufacturers was not provided during data collection for this inventory.

Under the Minamata Convention, the manufacture, import and export of skin-lightening creams with mercury content greater than 1 ppm is not allowed as of 2020.

Research conducted has shown that mercury has been found to be present in a skin-lightening cream manufactured in Jamaica. In a report by Hamann, et al. (2014), skin-lightening products from several countries such as China, Japan, Philippines, Thailand and Jamaica were analysed for mercury content and all were found to have mercury levels between 1,729 - 42,875 parts per million (ppm). Mohammed et al. (2017) analysed fifteen common skin-lightening creams from the European Union, India and Jamaica and found the highest mercury content in the product from Jamaica at a concentration of approximately 14,508 ppm. Analysis of a similar product from Jamaica by BRI in a 2018 report indicated a mercury concentration exceeding 29,000 ppm. The mercury presence in this product was due to the use of ammoniated mercury as an active ingredient. Stakeholder discussions during this inventory noted that as of 2015, the product manufacturers in Jamaica no longer list ammoniated mercury as an active ingredient. It is therefore recommended that further testing of recent batches of this product be done to determine its mercury content.

2.6 Data and Inventory on Other Intentional Product/Process Uses

2.6.1 Dental Mercury Amalgam Fillings

Dental mercury-amalgam is used to restore teeth with dental cavities. It is a mixture of liquid mercury and a powder containing silver, tin, copper, zinc and other metals (US EPA, 2016). It can be supplied to dentists in powder form, where pure mercury and powder of other metals are to be measured out and mixed in an agitator at the dental facility; or as small capsules, in which the mercury and the powder of other metals are pre-mixed in the right formula for immediate use in the facility.

Dental amalgam fillings have an approximate life-time of 10-20 years, and mercury can be released to air, water, products and general waste through its production, preparation in clinics, use and disposal. Mercury from placing dental amalgam fillings can be released when left-over amalgam is washed down sinks in a clinic or discarded in general waste, and when particles are expelled while adjusting the shape of the filling. Additionally, procedures to renew and replace dental amalgam lead to particulate releases into wastewater systems if dental chairs are not equipped with mesh filters or more efficient central filters. Low quantities of mercury are also continuously emitted from a person's mouth during use. Disposal occurs when teeth containing dental amalgam are removed, or when a person with dental amalgam fillings dies and is cremated or buried.

There are 260 registered dentists in Jamaica, and approximately 350 volunteer dentists who visit annually. The main types of dental fillings used in Jamaica are: 1) composite and 2) amalgam which consists of nearly 50% elemental mercury and a powdered alloy of silver, tin and copper. There has been a general phasing out of dental mercury amalgam in Jamaica, and a survey conducted as part of the 2016 Mercury Storage and Disposal Project (Jamaica, Suriname and Trinidad and Tobago) demonstrated that most private sector dentists use composite fillings (BCRC-Caribbean, 2016). However, numerous public-sector dentists still prepare, use and extract amalgam fillings which they typically purchase in a pre-mixed capsule, and some visiting volunteer dentists may make and use dental amalgams. Further, most dental chairs used are not

equipped with high efficiency amalgam filters, and releases of mercury often occur when dental amalgam is washed down sinks into wastewater streams.

Although alternative mercury-free fillings are available, the practice of using dental amalgam is perpetuated by the inclusion of a practical component in dental school curriculums at the University of Technology and the University of the West Indies which introduces dental students to mercury-amalgam fillings.

Questionnaires were sent to dental practitioners to gather specific information on mercury amalgam use (Annex III), however, the response rate was low so default calculations in the Toolkit spreadsheet were used to estimate releases of mercury from this sector. The estimated mercury inputs from preparation, use and disposal of dental amalgam were calculated using a default input factor of 0.2 g mercury consumed with dental amalgam per inhabitant, and considerations of the number of registered dental personnel per 1000 inhabitants in Jamaica (0.09) with adjustments made based on the country from which the default input factor was derived.

The total mercury input to Jamaica from the preparation of dental amalgam was calculated based on 2016 population data. The output to the environment from this life-cycle phase was noted to be a fraction of the input as it did not account for the mercury that would be released in subsequent years through use and disposal. The output using amalgam in 2016 was estimated using the mercury input from dental amalgam consumed 10 years prior, in 2006. These releases occurred from damaged fillings that were replaced or repaired in 2016, and from direct releases from the user's mouth during 2016. Mercury releases from the disposal of "spent" dental amalgam were determined from population data for 1996 since the expected end-of-life of dental amalgam is 20 years after consumption. Releases from cremation and burial of people with dental amalgam were also taken into consideration in the disposal life-cycle phase of dental amalgam. Population data for 2016, 2006 and 1996 were retrieved from the World Bank.

Overall, approximately 58.49 kg of mercury was estimated to have been released in Jamaica in 2016. However, as the prevalence of mercury dental amalgam has been low according to persons consulted, it is possible that the mercury releases estimated may

be an over-estimation. Further, it was noted by the Ministry of Health that dental amalgam is currently stored by health centres.

Data Gaps and Potential Follow Up

There was a low response rate for questionnaires distributed to the dental community to source-specific information on the prevalence of dental amalgam, the use of filters and other release controls in dental facilities, and disposal methods of “spent” amalgam. Also, estimated data did not factor in the numerous volunteer dentists that visit Jamaica annually. Further information is needed to confirm the proportion of dentists that use mercury amalgam and those that do not, to make more accurate estimations.

The priorities to fill identified gaps are to:

- Determine measures and incentives to increase the questionnaire response rate by dental practitioners to get more accurate information;
- Estimate the quantity of mercury amalgam used by volunteer dentists working in the country;
- Identify the proportion of dentists using amalgam for fillings and those that use composite material; and
- Confirm output distribution factors used through stakeholder consultation and testing.

Summary of Inputs and Results

Table 16 summarises the mercury inputs and releases to Jamaica from the preparation, use and disposal of dental mercury amalgam fillings during 2016.

Table 16: Analysis of mercury input and output factors for dental mercury amalgam fillings

Dental Mercury Amalgam Fillings	Unit	Preparation	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	Inhabitants	2,881,355 (2016)	2,760,279 (2006)	2,561,993 (1996)	-
Input factor for phase	g Hg/(y*inh.) dentists/1000 inh.	0.2 0.09	0.2 0.09	0.2 0.09	-
Calculated input to phase	kg Hg/y	62.55	59.92	55.62	-
Output distribution factors for phase:					
- Air	N/A	0.02	-	-	-
- Water	N/A	0.14	0.02	0.28	-
- Land	N/A	-	-	0.08	-
- Products	N/A	-	-	0.06	-
- General waste treatment	N/A	0.12	-	0.08	-
- Sector-specific waste treatment	N/A	0.12	-	0.08	-
Calculated outputs/releases to:					
- Air	kg Hg/y	1.25	-	-	1.25
- Water	kg Hg/y	8.76	1.20	15.57	25.53
- Land	kg Hg/y	-	-	4.45	4.45
- Products	kg Hg/y	-	-	3.34	3.34
- General waste treatment	kg Hg/y	7.51	-	4.45	11.96
- Sector-specific waste treatment	kg Hg/y	7.51	-	4.45	11.96

2.6.2 Manometers and Gauges with Mercury

Mercury is used in some blood pressure gauges, pressure valves, and industrial and meteorological manometers. Mercury was popularly used due to its high density and its effectiveness in responding to various pressure changes. Most mercury-containing devices are sphygmomanometers or blood pressure gauges. Non-mercury alternatives exist for all uses and are gradually being substituted for the mercury-using equivalents in some countries; though it was noted that there is some reluctance to promote mercury-free alternatives due to the belief that the mercury devices are more accurate (Palmer, 2016).

Based on Customs data, 100 medical blood pressure gauges were imported into Jamaica in 2016. The assumption was made that all these items contained mercury.

Using a default input factor of 80 g Hg/ item, an input of 8 kg mercury was calculated for this source category. Specific data on the importation, use and disposal of other manometers and gauges with mercury in Jamaica could not be obtained at the time of the inventory, so default input and output distribution factors available in the Toolkit spreadsheet were used to estimate mercury releases from these products. The releases may therefore be over-estimations. The data used for the Toolkit calculations were the country's 2014 electrification rate of 97%, as the 2016 value was not available, and 2016 population data; both sourced from the World Bank. Based on the Toolkit spreadsheet, 13.97 kg mercury were released from the use and disposal of other manometers and gauges with mercury.

It was assumed that there was no separate collection of this waste, but that informal handling was widespread. Releases from this source category were to air, water, land and general waste.

Data Gaps and Potential Follow Up

The main data gap for this source category was a lack of specific information on the quantity of mercury-containing manometers and gauges used and the ratio of mercury distribution to the various output pathways. Additionally, the amount of mercury used in the gauges recorded were not identified, and a default input factor, which may have been too high, was used. The electrification rate used was for 2014 instead of 2016. It can be assumed that the electrification rate for 2016 was higher than that for 2014. However, since the 2014 value is high, the change may not be significant.

The priorities to fill identified gaps are to:

- Identify quantities of mercury-containing manometers and gauges used in Jamaica and the amount of mercury contained in each item; and
- Determine the disposal methods used and the distribution of mercury to output pathways by this source.

Summary of Inputs and Results

The following table (Table 17) summarises the mercury inputs and releases to Jamaica from the use and disposal of mercury-containing manometers and gauges during 2016.

Table 17: Analysis of mercury input and output factors for manometers and gauges with mercury

Use and Disposal of Manometers and Gauges with Mercury	Unit	Use and Disposal		Sum of releases to pathway from assessed part of life-cycle
		Medical Blood Pressure Gauges	Other Manometers	
Activity rate	items/y	100	N/A	-
	inhabitants	N/A	2,881,355	
Input factor for phase	g Hg/item	80	N/A	-
	g Hg/y*inhabitant	N/A	0.005	
Calculated input to phase	kg Hg/y	8.00	13.97	-
Output distribution factors for phase:				
- Air	N/A	0.2	0.2	-
- Water	N/A	0.3	0.3	-
- Land	N/A	0.2	0.2	-
- Products	-	-	-	-
- General waste treatment	N/A	0.3	0.3	-
- Sector-specific waste treatment	-	-	-	-
Calculated outputs/releases to:				
- Air	kg Hg/y	1.60	2.79	4.39
- Water	kg Hg/y	2.40	4.19	6.59
- Land	kg Hg/y	1.60	2.79	4.39
- Products	-	-	-	-
- General waste treatment	kg Hg/y	2.40	4.19	6.59
- Sector-specific waste treatment	-	-	-	-

2.6.3 Laboratory Chemicals and Equipment with Mercury

Mercury is used in laboratories as instruments, reagents, preservatives and catalysts, such as mercury electrodes. Mercury has also been commonly used in thermostat equipment, whether as a component in electrical switches or as a major component for the thermostat function. For example, mercury may be used in “accustat” thermostats to switch on and off the electrical flow, or in mercury thermostat probes (UN Environment, 2017a). Most of the mercury in labs is released into wastewater and general waste, but some may be released via laboratory vents.

Elemental mercury and its compounds are present mainly in educational institutions, such as the University of the West Indies, Mona Campus. In 2016, Jamaica imported

31,965 kg of organic and inorganic compounds of mercury (excluding amalgams) according to the Statistical Institute of Jamaica. Equipment with mercury, such as thermostats (41,071 kg) and centrifuges (10,699 items) were also imported in 2016. Electron Capture Detectors (ECD) present at the Pesticide Research Lab (Chemistry Department, UWI, Mona), Veterinary Services Division (Ministry of Industry, Commerce, Agriculture and Fisheries) and at a local brewery have a small concentration of mercury according to the supplier. ECDs are used in gas chromatography to detect trace amounts of compounds in a sample.

While some data on the laboratory chemicals and equipment used in Jamaica were available, the mercury content was unknown, and default calculations available in the Toolkit spreadsheet were used to estimate the mercury releases from laboratory chemicals and equipment. The data used for the Toolkit calculations were the country's 2014 electrification rate of 97%, as the 2016 value was not available, and 2016 population data; both sourced from the World Bank. As the 2014 electrification rate was the most recently available datum, it was assumed that there was no significant difference between 2014 and 2016 electrification rate, for the purpose of the inventory calculations.

For 2016, 27.95 kg and 111.8 kg were estimated as the input to Jamaica's society from lab chemicals and other lab equipment respectively. The accuracy of these estimates is uncertain. Output to water from cleaning up spillages and washing equipment was determined to be 46.12 kg. Releases to general waste and sector specific treatment and disposal were estimated as 46.12 kg and 47.52 kg respectively.

Data Gaps and Potential Follow Up

The main data gap for this source category was a lack of specific information on the amount of mercury contained in the imported items. Also, the quantity of mercury containing ECDs and potential mercury input is unknown. Additional information is needed to confirm the distribution of mercury to the various output pathways. Default output factors which do not consider releases to air were used. Further, disposal methods were not specified and the proportion of releases to general waste may not be approximately equal to releases to sector-specific treatment.

The electrification rate used was for 2014 instead of 2016. It can be assumed that the electrification rate for 2016 was higher than that for 2014, however, since the 2014 value is already high, the change may not be significant.

The priorities to fill identified gaps are to:

- Identify the mercury content/ kg organic and inorganic compounds of mercury (excluding amalgams) imported in 2016;
- Determine the electrification rate for 2016;
- Determine the mercury content/ kg thermostats and the mercury content/ item for centrifuges imported in 2016;
- Quantify ECDs imported in 2016 and determine mercury content; and
- Determine the disposal methods used and the distribution of mercury to output pathways by this source.

Summary of Inputs and Results

Table 18 summarises the mercury inputs and releases to Jamaica from the use and disposal of laboratory chemicals and equipment during 2016.

Table 18: Analysis of mercury input and output factors for lab chemicals and equipment with mercury

Use and Disposal of Laboratory Chemicals and Equipment with Mercury	Unit	Use and Disposal		Sum of releases to pathway from assessed part of life-cycle
		Laboratory Chemicals	Other Laboratory Equipment	
Activity rate	inhabitants	2,881,355	2,881,355	-
Input factor for phase	g Hg/y*inhabitant	0.01	0.04	-
Calculated input to phase	kg Hg/y	27.95	111.80	-
Output distribution factors for phase:				
- Air	-	-	-	-
- Water	N/A	0.33	0.33	-
- Land	-	-	-	-
- Products	-	-	-	-
- General waste treatment	N/A	0.33	0.33	-
- Sector-specific waste treatment	N/A	0.34	0.34	-
Calculated outputs/releases to:				

Use and Disposal of Laboratory Chemicals and Equipment with Mercury	Unit	Use and Disposal		Sum of releases to pathway from assessed part of life-cycle
		Laboratory Chemicals	Other Laboratory Equipment	
- Air	-	-	-	-
- Water	kg Hg/y	9.22	36.89	46.12
- Land	-	-	-	-
- Products	-	-	-	-
- General waste treatment	kg Hg/y	9.22	36.89	46.12
- Sector-specific waste treatment	kg Hg/y	9.50	38.01	47.52

2.6.4 Miscellaneous Product Uses with Mercury and Other Sources

In Jamaica, it is possible that other miscellaneous products containing mercury are in use, however, specific data on these sources were not found. The items shown in Table 19 should be studied further to confirm their presence throughout Jamaica and the potential for mercury releases to occur through production, use and disposal activities.

Table 19: Potential presence of miscellaneous product uses with mercury

Miscellaneous Product Uses with mercury	Identified as Present (Y), Possible but Not Positively Identified (?) and Absent (N)
Bougie tubes and Cantor tubes	*Y*
Educational uses	*Y*
Tanning	*Y*
Pigments	*Y*
Certain colour photograph paper types	*Y*
Recoil softeners in rifles	*Y*
Explosives (mercury-fulminate a.o.)	*Y*
Fireworks	*Y*
Executive toys	*Y*
Mercury metal use in religious rituals and folklore medicine	*?*
Miscellaneous product uses, mercury metal uses, and other sources	*?*
Infrared detection semiconductors	*?*
Gyroscopes with mercury	*?*
Vacuum pumps with mercury	*?*
Use of mercury as a refrigerant in certain cooling systems	*?*
Light houses (Marine navigation lights)	*?*
Mercury in large bearings of rotating mechanic parts in for example older waste water treatment plants	*N*
Browning and etching steel	*N*

2.7 Data and Inventory on Waste Handling

2.7.1 Incineration and Burning

There are incinerators located at the sole cement manufacturing facility, and at other sites managed by the Ministry of Health, Ministry of National Security and a private meat supplier company. General waste is incinerated by the Airports Authority. The Ministry of Health incinerates medical wastes such as pharmaceutical items and general waste such as papers and consumable products. However, other medical wastes such as broken mercury thermometers, mercury sphygmomanometers and dental amalgams are presently being stored at health centres. Hazardous waste and sewerage sludge are not incinerated in Jamaica, and informal waste burning, though potentially present, was not confirmed.

Throughout Jamaica, excluding Kingston, waste disposal continues to depend on aging incinerators and burn boxes (NEPA, 2013). These incinerators are known to emit dioxins, furans and volatile organic compounds, and may potentially release mercury and mercury compounds which are dangerous to public health. Furthermore, the Ministry of Health confirms that due to the limited capacity of these incinerators, there is an urgent need to replace many of them.

Data on the volumes of waste incinerated was not available for entry into the inventory. Determination of the mercury input from this category should be prioritised as releases to air may be significant.

2.7.2 Controlled Landfills/Deposits[10]

There are eight (8) authorised public solid waste disposal sites distributed across Jamaica, which are managed by the National Solid Waste Management Authority (NSWMA). The NSWMA has demarcated the country for its management purposes into four (4) Regions otherwise termed “waste-sheds”: Riverton, Retirement, Southern and North-eastern. Each region is made up of two (2) or more Parishes, with accompanying

[10] In this report, controlled landfills/deposits refer to locations which are authorised waste disposal locations.

disposal sites for the proper disposal of solid waste to ensure environmental protection, prevention of solid waste disease, and pest or nuisance control (NSWMA, 2015). According to the Waste Characterisation Study of the NSWMA, 2015, the status of eight (8) disposal sites in the country are as outlined in Table 20.

Table 20: Description of disposal sites in Jamaica (NSWMA, 2015)

Location	Disposal Site	Parishes Served	Acreage (ac)[11]	Volume (Tonnes) 2014	Status
St. Catherine	Riverton	Clarendon, Kingston and St. Andrew; St. Catherine	106	390,585	Active
St. Thomas	Church Corner	St. Thomas	3	17,760	Active
Portland	Doctorswood	Portland	7.4	17,522	Active
St. Ann	Haddon	St. Ann and St. Mary	9	25,053	Active
St. Ann	Tobolski	St. Ann	12.2	8,342	Active
St. Elizabeth	Myersville	St. Elizabeth	9	15,348	Active
Manchester	Martin's Hill	Manchester	19	61, 976	Active
St. James	Retirement	Trelawny; St. James; Hanover; Westmoreland	27	153,222	Active

These sites are not sanitary landfills, and as such no major safeguards are in place to prevent contaminants from eventually entering the environment (UN Environment, 2017b).

The Riverton disposal site is the largest disposal site in the country and is responsible for in-taking approximately 60% of the country's waste. General waste is typically compacted and regularly covered over with soil (Figure 16). The country's hazardous waste is also sent to the Riverton site where specific categories are separated from general waste; for example, some types of e-waste is segregated and stored on-site. However, household wastes are unsegregated. Informal sorting of discarded wastes occurs by waste pickers located at the disposal site (Figure 17).

[11] This indicates the total acreage of each site; though it is important to note that the entire site is not used for waste deposition.



Figure 16: Covered (foreground) and uncovered (background) garbage at the Riverton Landfill (Photo credit: April Johnson, 2017)

To manage hazardous waste streams, the Government of Jamaica, with support from the Strategic Approach to International Chemicals Management (SAICM) Quick Start Programme Trust Fund (QSPTF) developed and implemented a public education and awareness campaign on electrical and electronic wastes as part of the National Programme on environmentally sound management of e-wastes. Additionally, a pilot project was undertaken to collect used and end-of-life mobile and computing equipment in 2015 across several communities. Regulations were also drafted under the National Solid Waste Management Act to govern e-wastes.

In Kingston, the disposal of medical waste has improved since November 2012 due to the opening of the National Medical Waste Management Plant (NEPA, 2013). The plant uses a non-incineration automated system to treat medical waste, which involves steam sterilisation followed by shredding to reduce waste volumes and facilitate safe handling prior to disposal. The Ministry of Health currently treats around 65,000 kg of medical waste per month and covers approximately 60% of medical waste in Kingston and St. Andrew.



Figure 17: Informal sorting of plastics at Riverton Landfill
(Photo Credit: April Johnson, 2017)

In 2014, the combined total volume of solid waste disposed of at the 8 public facilities was calculated to be 689,808 tonnes. As waste disposal practices did not vary significantly since 2014 to 2016, it was assumed that the corresponding disposal rate for 2016 would be comparable to the recorded 2014 volume. Default input factors and output distribution factors were used to determine the mercury input and releases to Jamaica from landfilling.

The estimated input for the year was determined to be 6,898 kg, with a primary output of 68.98 kg to air. Mercury in the landfills are secondarily sourced from discarded end-of-life mercury-added products such as light sources, batteries, cosmetics, medical devices and lab equipment; and industrial wastes from processes such as cement production, oil refining and incineration.

Test of Waste Default Factors

In this inventory, default input factors were used for the estimation of mercury releases from general waste treatment. The default factors were based on literature data of mercury contents in waste, and these data were only available from developed

countries. The following test of the results was performed to qualify the results for these sources.

The test made for general waste compares the calculated inputs to all four (4) general waste subcategories; i.e. incineration of municipal/general waste (E62[12]), informal waste burning (E66), controlled landfills/deposits (E68) and informal dumping of general waste (E71), with the sum of general waste outputs from gold (and silver) extraction with mercury amalgamation processes (J24) and the intentional use of mercury in products and processes (J37 to J56) as follows, using data from the Inventory Level 2 Spreadsheet (IL2).

In the IL2 spreadsheet, the test was done as follows;

$$Tab \text{ "Level 2-Summary"}: (E62 + E66 + E68 + E71) > \left(2 \times \left(J24 + \sum (J37 \; to \; J56)\right)\right)$$

$$(69.67 \; kg \; > 410.82 \; kg)$$

The derived expression is therefore false, and the calculations made indicate that the default input factors for general waste does not necessarily over-estimate the mercury releases from these sub-categories. It is important to note, however, that there are data gaps for mercury releases from several categories of products and processes, and the quantities of general waste disposed through incineration of municipal/general waste, informal waste burning, and controlled landfills/deposits were not determined. This assessment should be redone when new information is obtained.

Data Gaps and Potential Follow Up

The 2016 landfilled waste volume should be determined to verify that there was not a significant change in mercury input from 2014 to 2016. Further research should be conducted to determine specific input and output distribution factors for this source category, including the impact on informal waste handlers on mercury releases.

[12] Values refer to the cells used from the Level 2-Summary sheet in the Inventory Level 2 Spreadsheet. The full spreadsheet is available in Annex IV of this report.

Summary of Inputs and Results

Table 21 summarises the mercury inputs and releases to Jamaica from controlled deposits of waste.

Table 21: Analysis of mercury input and output factors for uncontrolled landfilling of waste

Controlled Deposits	Unit	Informal Dumping of General Waste	Sum of releases to pathway from assessed part of life-cycle
Activity rate	t waste dumped/y	689,808	-
Input factor for phase	g Hg/t waste dumped	10	-
Calculated input to phase	kg Hg/y	6,898	-
Output distribution factors for phase:			
- Air	N/A	0.01	-
- Water	N/A	0.0001	-
- Land	N/A	-	-
- Products	-	-	-
- General waste treatment	-	-	-
- Sector-specific waste treatment	-	-	-
Calculated outputs/releases to:			
- Air	kg Hg/y	68.98	-
- Water	kg Hg/y	0.69	-
- Land	kg Hg/y	-	-
- Products	-	-	-
- General waste treatment	-	-	-
- Sector-specific waste treatment	-	-	-

2.7.3 Wastewater System/Treatment

Mercury in wastewater originates from the two main source groups:

- Intentionally used mercury in products such as dental amalgams, thermometers and other devices, and processes such as industrial discharges; and
- Atmospheric mercury originating from both natural and anthropogenic sources that is washed out by precipitation and which goes into storm drains.

Therefore, wastewater systems are an intermediate mercury release pathway, where the mercury will either be released into the waterways after treatment of waste water or

distributed through sludge as fertiliser on land or to waste deposited at the landfill (UN Environment, 2017a).

Wastewater treatment processes can include different stages - primary (involves mechanical filtration of debris, sand and sludge); secondary (involves clarification and disinfection through processes involving chlorine or ultraviolet light) and; tertiary (involving nutrient removal) (Figure 18).

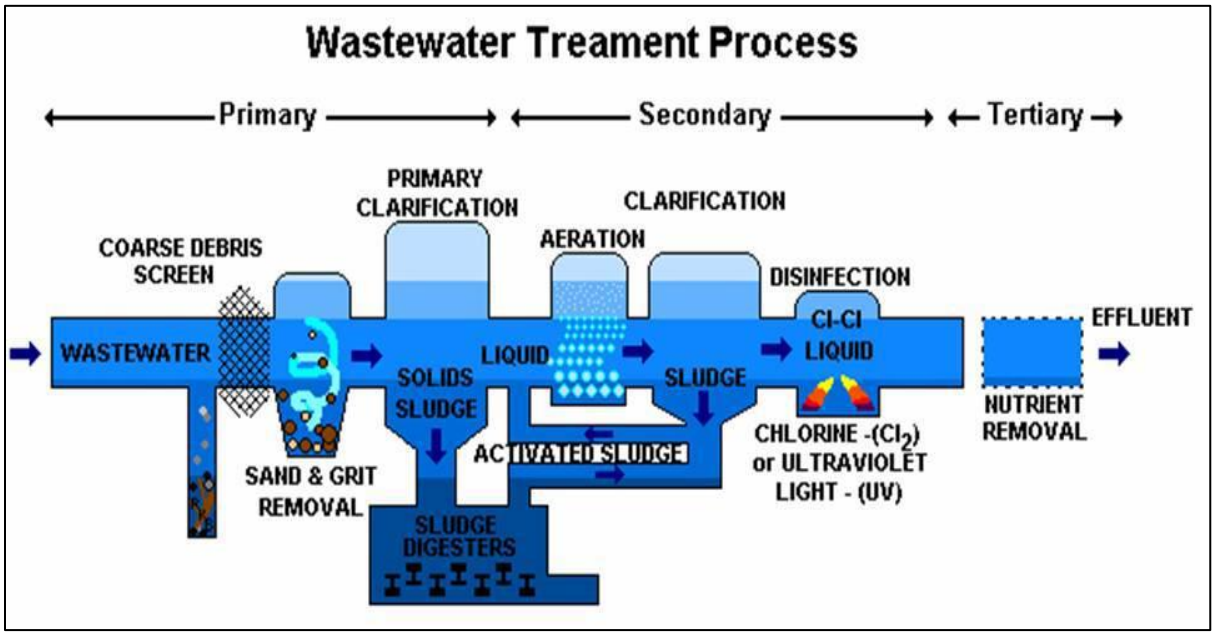

Figure 18: Wastewater treatment process
(Source: Sonka, 2012)

As of 2013, there were currently a total of 234 sewage treatment plants (STPs) monitored by the National Environment and Planning Agency (NEPA) throughout Jamaica (Table 22). A total of 73 STPs were under the management of the National Water Commission (NWC), the statutory body responsible for providing potable water supply and wastewater services to most of the population of Jamaica. The remaining STPs are owned and/or operated by the hotel sector, other government agencies, hospitals, private companies and public housing development agencies.

Table 22: Number of sewage treatment plants in Jamaica according to parish and watershed

Name of Parish	Watershed	No. of Plants (2013)
Kingston & St. Andrew	Rivers: Hope, Yallahs, Wagwater & Rio Cobre	44
Portland	Rivers: Rencar-Buff Bay, Spanish, Swift, Rio Grande & Drivers	12
St. Thomas	Rivers: Yallahs, Morant, Plantain Garden River, Rio Grande, Drivers	6
Clarendon	Rivers: Milk River, Rio Bueno, White & Rio Minho	21
Manchester	Rivers: Black, Gut-Alligator Hole, Milk & Rio Bueno-White River	8
St. Ann Rivers:	Rio Bueno-White River	25
St. Catherine	Rivers: Rio Cobre, Milk River	51
St. Mary	Rio Bueno-White, Oracabessa Pagee, Rio Nuevo, Wagwater Pencar-Buff B	12
Hanover	Rivers: South Negril-Orange, Cabarita, Lucea & Great River	6
St. Elizabeth	Rivers: Black River Gut Alligator Hole	6
St. James	Rivers: Great River, Black River, Montego River, Martha Brae	21
Trelawny	Rivers: Martha Brae, Rio Bueno, White River, Black	8
Westmoreland	Rivers: S. Negril-Orange, Dean's Valley, New Savannah, Black & Great	14
TOTAL		**234**

The types of wastewater treatment facilities used in the island include oxidation ditch, activated sludge, waste stabilisation pond, and primary treatment; all of which are biological, and some mechanical. There is generally no land application of sludge.

Soapberry Sewage Treatment Plant, located in St. Catherine, is the largest facility in Jamaica. It serves Kingston, St. Andrew and St. Catherine, and has a maximum capacity of 30 million m^3 per year. No mercury analysis is conducted at this site.

Figure 19 shows the wastewater treatment plant in Elleston Flats in the parish of St. Andrew. This plant has facilities for nutrient removal, as well as for processing sludge for reuse in land applications under specific conditions.



Figure 19: Tertiary treatment plant, Elleston Flats, Kingston
(Photo Credit: April Johnson, 2017)

An example of a secondary treatment plant in Jamaica can be seen in Figure 20. The facility has mechanisms for aeration and disinfection, though no applications for nutrient removal are incorporated.



Figure 20: Secondary treatment plant, Innswood, St. Catherine
(Photo Credit: April Johnson, 2017)

All wastewater treatment systems in Jamaica must meet standards for effluent output as prescribed under the Natural Resources Conservation (Wastewater and Sludge) Regulations (2013) which are detailed in Section 3.1.2 of this report.

The total capacity of 68 STPs monitored by NWC was 240.59 million litres per day. This value was converted to m^3 per year using the conversion factor of

$$1.0\ x\ 10^6\ {}^{L}/_{day} = 3.65\ x\ 10^5\ {}^{m^3}/_{year}.$$

The activity rate used in the Toolkit was 87,815,350 m^3/year based on the assumption that the 68 STPs operated at full capacity throughout the entire year. The resulting mercury input to Jamaica was calculated to be 461.03 kg for 2016 using a default input factor. The calculations made do not account for the treatment operations from the remaining five (5) plants that were managed by the NWC in 2013 and 161 STPs managed by other agencies.

The most significant mercury output was estimated to be to water, 230.52 kg due to mercury contained in treated plant effluents. Similarly, general waste was determined to be the secondary output pathway, 138.31 kg, and the remainder was projected to be released to sector-specific treatment/disposal.

Test of Wastewater Default Factors

In this inventory, default input factors were used for the estimation of mercury releases from wastewater treatment. The default factors were based on literature data of mercury contents in wastewater, and these data were only available from developed countries. The following test of the results was performed to qualify the results for these sources.

The test made for wastewater compares the calculated inputs to wastewater treatment (E72[13]) with the sum of outputs to water from gold (and silver) extraction with mercury amalgamation processes (G24) and the intentional use of mercury in products and processes (G37 to G56) as follows, using data from the Inventory Level 2 Spreadsheet (IL2).

[13] Values refer to the cells used from the Level 2-Summary sheet in the Inventory Level 2 Spreadsheet. The full spreadsheet is available in Annex IV of this report.

In the IL2 spreadsheet, the test was done as follows;

$$Tab \text{ "Level 2-Summary": } (E72) > \left(2 \times \left(G24 + \sum (G37 \; to \; G56)\right)\right)$$

$$(461.03 \; kg \; > 105.9 \; kg)$$

The derived expression is true as 461.03 kg is greater than 211.8 kg. Therefore, the calculations indicate that the default input factor for wastewater treatment may over-estimate the mercury releases from this sub-category. It is important to note, however, that there are data gaps for mercury releases from several categories of products and processes, and this assessment should be redone when new information is obtained.

Data Gaps and Potential Follow Up

Wastewater from only 68 of the 234 sewage treatment plants (STPs) monitored by NEPA in 2013 were considered in the inventory calculations. As such, it is highly likely that the activity rate used was lower than the national water treatment rate for 2016. Further, the activity rate used for the 68 plants was the combined total capacity of the plants, and not the actual rate of wastewater treated daily. The total capacity reflects the maximum volume of water that could be treated daily and is therefore potentially an overestimation of the real operational volumes. The default input and output distribution factors used may also not be accurate.

The priorities to fill identified gaps are to:

- Determine the annual volumes of wastewater treated by all operating sewage treatment plants in Jamaica;
- Identify the mercury content/m^3 wastewater treated and released; and
- Estimate mercury output to various pathways from this source by assessing disposal methods.

Summary of Inputs and Results

Table 23 summarises the mercury inputs and releases to Jamaica from wastewater systems and treatment.

Table 23: Analysis of mercury input and output factors for wastewater systems and treatment

Wastewater System/Treatment	Unit	Operation of wastewater systems	Sum of releases to pathway from assessed part of life-cycle
Activity rate	m^3 wastewater/y	87,815,350	-
Input factor for phase	mg Hg/m^3 waste	5.25	-
Calculated input to phase	kg Hg/y	461.03	-
Output distribution factors for phase:			
- Air	-	-	-
- Water	N/A	0.5	-
- Land	-	-	-
- Products	-	-	-
- General waste treatment	N/A	0.3	-
- Sector-specific waste treatment	N/A	0.2	-
Calculated outputs/releases to:			
- Air	-	-	-
- Water	kg Hg/y	230.52	230.52
- Land	-	-	-
- Products	-	-	-
- General waste treatment	kg Hg/y	138.31	138.31
- Sector-specific waste treatment	kg Hg/y	92.21	92.21

2.8 Data and Inventory on Crematoria and Cemeteries

Mercury may be released from crematoria during the cremation process and cemeteries from decay after burial due to the presence of dental amalgam fillings in the corpse's teeth and small amounts of mercury accumulated in body tissue from the consumption of contaminated fish and use of mercurial compounds (UN Environment, 2017a). Mercury is released primarily to the air from crematoria and to land from cemeteries.

Based on 2016 population data, 2,881,355 (World Bank, 2017) and the death rate, 6.7 deaths per 1,000 persons (Index Mundi, 2017), the number of deaths in Jamaica was calculated to be 19,305. This value is closely related to 2014 data from the Registrar's General Department which indicated that there were 19,755 registered deaths in 2014. Although there has been an increase in the number of cremations in Jamaica due to its lower cost and other factors, most corpses are still buried.

There are 50 funeral homes in Jamaica. A survey of funeral home operators was conducted under this project, and based on responses, it was estimated that approximately 75% of corpses are buried while the remaining 25% are cremated in one (1) of four (4) crematoria in Jamaica. These percentages were applied to the number of registered deaths, and it was therefore estimated that approximately 4,826 corpses were cremated in 2016, and 14,479 were buried. Mercury input to Jamaica was 12.07 kg from crematoria, released primarily to the air, and 36.2 kg from cemeteries, output mainly to land in 2016.

Data Gaps and Potential Follow Up

Default factors were used which could have under- or over- estimated the input and releases from these categories. The main priority should be to conduct assessments on the release of mercury to land and water from cemeteries, and to determine the disposal methods used by crematoria for flue ash and other residues from incineration.

Summary of Inputs and Results

Table 24 summarises the mercury inputs and releases to Jamaica from crematoria and cemeteries.

Table 24: Analysis of mercury input and output factors for crematoria and cemeteries

Crematoria and Cemeteries	Unit	Crematoria	Cemeteries	Sum of releases to pathway from assessed part of life-cycle
Activity rate	corpses cremated/y	4,826	-	-
	corpses buried/y	-	14,479	
Input factor for phase	g Hg/corpse	2.5	2.5	-
Calculated input to phase	kg Hg/y	12.07	36.20	-
Output distribution factors for phase:				
- Air	N/A	1.0	-	-
- Water	-	-	-	-
- Land	N/A	-	1.0	-
- Products	-	-	-	-
- General waste treatment	-	-	-	-
- Sector-specific waste treatment	-	-	-	-
Calculated outputs/releases to:				
- Air	kg Hg/y	12.07	-	12.07
- Water	-	-	-	-
- Land	kg Hg/y	-	36.20	36.20
- Products	-	-	-	-
- General waste treatment	-	-	-	-
- Sector-specific waste treatment	-	-	-	-

2.9 Stocks of Mercury and/or Mercury Compounds, and Storage Conditions

Under Article 3 of the Minamata Convention, each Party shall endeavour to identify individual stocks of mercury or mercury compounds over 50 metric tonnes, as well as sources of mercury supply generating stocks exceeding 10 metric tons per year, that are located within its territory.

Based on the inventory it was determined that stocks of the above-mentioned quantity are not present in Jamaica.

2.10 Supply and Trade of Mercury and Mercury Containing Compounds Including Sources, Recycling Activities and Quantities

Under Article 3 of the Minamata Convention, “mercury” and “mercury-containing compounds” refer to mixtures of mercury with other substances, mercury (I) chloride, mercury (II) oxide, mercury (II) sulphate, mercury (II) nitrate, cinnabar and mercury sulphide. Based on the inventory, it was determined that no significant sources of, nor recycling activities of, mercury and mercury compounds are present in Jamaica.

2.11 Contaminated Sites

Article 12 of the Minamata Convention on Mercury states that Parties should “develop appropriate strategies for identifying and assessing sites contaminated by mercury or mercury compounds.” Risk reduction activities should be conducted using environmentally sound measures and should incorporate an assessment of the risks to human and environmental health from present mercury or mercury compounds.

Hot-spots of mercury contamination exist as the direct result of the use and release of mercury in processes, such as those at oil and gas facilities, leading to deposition on-site, as well as the inadequate disposal of mercury-contaminated materials in landfills. The potential presence of such hot spots was indicated by stakeholders at the National Inception Workshop held in April 2017 and is shown in Table 25.

Table 25: Identification of potential hot spots of mercury in Jamaica; Sources present (Y), absent (N), and possible but not positively identified (?)

Potential hot spots	Source presence (y/n/?)
Closed/abandoned chlor-alkali production sites	**N**
Other sites of former chemical production where mercury compounds are/were produced (pesticides, biocides, pigments etc.), or mercury or compounds were used as catalysts (VCM/PVC etc.)	**N**
Closed production sites for manufacturing of thermometers, switches, batteries and other products	**Y**
Closed pulp and paper manufacturing sites (with internal chlor-alkali production or former use of mercury-based slimicides)	**Y**
Tailings/residue deposits from mercury mining	**N**
Tailings/residue deposits from artisanal and large-scale gold mining	**N**
Tailings/residue deposits from other non-ferrous metal extraction	**Y**
Sites of relevant accidents	**N**
Dredging of sediments	**Y**
Sites of discarded district heating controls (and other fluid controls) using mercury pressure valves	**N**
Sites of previous recycling of mercury ("secondary" mercury production)	**N**

It was noted by the JBI that bauxite residues were previously discharged to unlined depressions in the 1950s and 60s. While these practices were dis-continued, the historic disposal methods may have resulted in possible contamination which should be

examined. Other potential sources of site contamination may derive from dumping of mercury-contaminated flue ash from the oil refining, cement and lime aggregate industries.

Confirmation of the existence of contaminated sites and specific details on the characteristics of the potential hot spots identified were not obtained, and these areas may be addressed and characterised in future efforts.

To assist Jamaica in the identification of contaminated sites, BRI collected national-scale spatial data on the location of waste disposal sites as well as bauxite sites. Data was also obtained on ecosystem types, major watersheds and topography. This data was used to develop a model to improve the understanding of areas potentially sensitive to mercury contamination. Identifying these spatial patterns in sensitivity is important for improving targets for monitoring and mitigation efforts. Due to the characteristics of mercury contamination in the environment, watershed and catchment areas were used as the units of analysis and examined in Jamaica (Buck and Burton, 2017).

The predictor variables accepted for use in Jamaica are shown in Table 26. The percent coverage of rice, ponds, lakes, and swamps were not relevant, and wetland occurrence data was not needed for the mercury sensitivity by watershed analysis in Jamaica.

Table 26: Predictor variables accepted and used to analyse mercury sensitivity by watershed

Parameter	Predictor Variable	Jamaica (X=Present)
Percent Coverage	Mangrove	X
	Forest Cover	X
	Agriculture	X
	Rice	
	Wetlands	X
	Waterbodies	X
	Ponds, Lakes, Swamps	
	Ponds, Lakes	
Occurrence Data	Wetlands	
	Landfills and Disposal Sites	X
	Wastewater Treatment Plants	X
	Bauxite Plants	X

After a ranking was assigned to each watershed for each predictor variable available in Jamaica, the rankings were summed across each watershed or catchment. An increasing number of assigned total points indicate the presence of a set of variables that combine to expose the watershed to increased sensitivity to mercury contamination. To compare watersheds across other Caribbean countries with varying numbers of predictor variables, the results were normalised by dividing the total cumulative points of each watershed by the maximum number of points that could be awarded for each individual watershed to create a final proportional ranking (Buck and Burton, 2017). Figure 21 shows the results of this study.

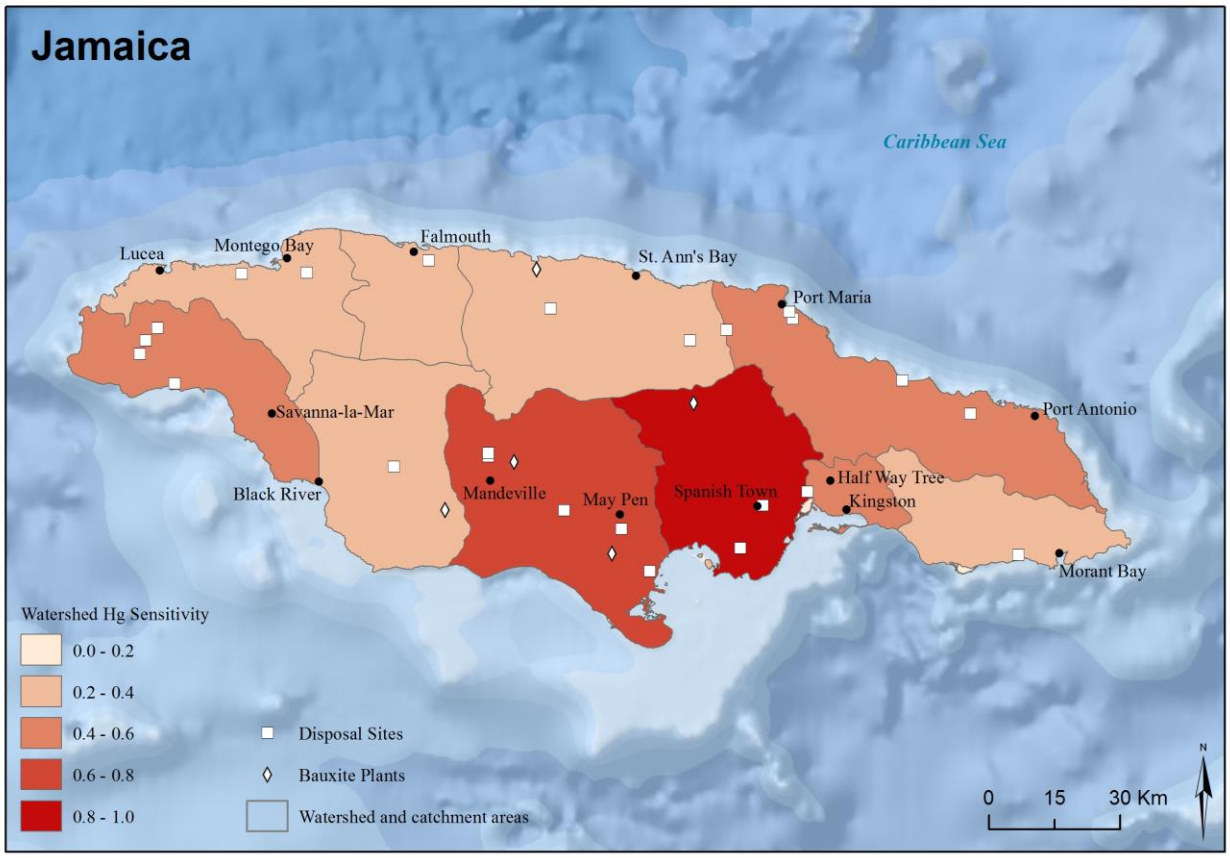

Figure 21: Jamaica watershed mercury sensitivity analysis results (Source: BRI, 2018)

The results of the analysis show that the watersheds surrounding Spanish Town are the most sensitive to mercury contamination, compared to other sites. It was also noted that the location of 3 of the 4 bauxite plants present were in areas of watershed sensitivity to

mercury above 0.6. The relationship between mercury sensitivity and disposal sites, however, cannot be confirmed from these results since disposal sites are dispersed throughout the country and are not notably concentrated in higher sensitivity areas.

To further optimise the analysis, the presence and location of additional potential sources of mercury should be verified. To do this, the relevant authorities should confirm the status of all bauxite plants and related disposal sites and document the location of informal dumping sites. Other potential point sources of mercury inputs to society should also be identified.

2.12 Impacts of Mercury on Human Health and the Environment

Mercury is noted to be toxic to humans and the environment when it forms the organic compound, methylmercury. The process of methylation, whereby mercury is converted to methylmercury, varies widely across various landscapes and within waterscapes. Areas that are particularly sensitive to mercury deposition generally represent aquatic ecosystems or have an aquatic connection within the food web. Methylmercury tends to biomagnify in food webs and bioaccumulate over time in organisms which are then consumed by humans. Fish from the sea or freshwater systems can be a major source of methylmercury, and it has been determined that generally, predatory species that are long-lived and grow larger can contain higher levels of methylmercury, though it may vary from species to species (BRI, 2018).

Methylmercury is a neurotoxin which can cause physiological harm and behavioural disorders in people. As stated in Section 1.2 of this report, previous studies in Jamaica and the wider Caribbean have indicated the presence of methylmercury in commonly consumed local fish. The indication that mercury may have effects on human health and ecology in Jamaica demonstrates a need for further investigation into the quantities of mercury being released into the environment to fully understand what should be done to eliminate this toxic metal and reduce its impacts. Chapters 4 and 5 of this report detail further the risks of exposure to mercury by the population.

Chapter III: Policy, Regulatory and Institutional Framework Assessment

An assessment of the policy, regulatory and institutional framework was conducted by the legal consultant hired under Component 2 of the MIA project, Dr. Winston McCalla. The following has been extracted from Dr. McCalla's Report, "Assessment of, and Recommendations for, the Legislative and Institutional Framework in Relation to the Implementation of the Minamata Convention on Mercury in Jamaica, Saint Kitts and Nevis, Saint Lucia, and Trinidad & Tobago", 2018.

3.1 Assessment of Policy

3.1.1 Existing Policies

This section deals with policies that are related to mercury or potentially related to mercury.

The Draft National Minerals Policy

The Draft National Minerals Policy 2014-2030 put forward the objectives and strategies for the sustainable development of Jamaica's minerals sector.

Mining is considered a solid base to the national economy and is also vital to Jamaica's diversification because of its impact on, and linkages with other sectors. Jamaica's minerals operations are located primarily in rural and semi-rural districts and therefore play a major role in providing the livelihood of many persons in these communities.

The National Minerals Policy will recognise that a modern and vibrant minerals sector must be based on a well-functioning mining industry. This involves ensuring strong institutions, modern legislation, strategic investments, and the use of profits and revenue derived from the sector and coexistence with other interests throughout the economy.

Draft National Policy for the Environmentally Sound Management of Hazardous Wastes (December 2017)

The Draft National Policy for the Environmentally Sound Management of Hazardous Wastes seeks to provide a framework within which all stakeholders can collaborate to

address hazardous waste management. This Policy articulates an integrated and coordinated approach to safeguard human health and the environment.

The Policy is based on a life cycle approach to hazardous waste management which is in keeping with Jamaica's obligations under key multilateral environmental agreements and arrangements related to the management of chemicals and hazardous wastes. These include the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (the Basel Convention), the Stockholm Convention on Persistent Organic Pollutants and the Minamata Convention on Mercury. The goal of this policy is for the environmentally sound management of hazardous wastes in Jamaica in keeping with international and regional best practices, to ensure the protection of human health and the environment.

3.2 Assessment of Legislation

This section reviews the legislation related to mercury or potentially related to mercury.

3.2.1 Existing Legislation

The Natural Resources Conservation Authority Act, 1991

This Act seeks to provide for "the effective management of the physical environment of Jamaica so as to ensure the conservation, protection and proper use of its natural resources ...". More specifically, the Act empowers the Natural Resources Conservation Authority (NRCA) (the National Environment and Planning Agency works on behalf of the NRCA) to:

a) "formulate standards and codes of practice to be observed for the improvement and maintenance of the quality of the environment generally, including the release of substances into the environment in connection with any works, activity or undertaking;

b) investigate the effect on the environment of any activity that causes or might cause pollution or that involves or might involve waste management or disposal, and take such action as it thinks appropriate;

c) undertake studies in relation to the environment and encourage and promote research into the use of techniques for the management of pollution and the conservation of natural resources."

There are specific regulations promulgated under this Natural Resources and Conservation Authority Act, 1991 which directly address mercury releases and emissions. For example, the Natural Resources Conservation (Air Quality) Regulations 2006 specifically places a limit on mercury emissions. Air pollution is also regulated under the Natural Resources Conservation (Ambient Air Quality Standards) Regulations, 1996. Under these Regulations mercury is classified as a toxic air pollutant.

Under section 17 of the Natural Resources Conservation Authority Act, NEPA may require the owner or operator of any sewage treatment plant, industrial waste treatment facility, or any facility for the disposal of solid waste, for the abatement of air pollution or for controlling pollution to submit information on pollution controls. This information would relate to the performance of the facility, the quantity and condition of effluent discharged, and the area affected by the discharge of effluent. However, under subsequent regulations (described below) reporting requirements of the Section 17 Pollution Control Forms are being superseded by newer legislation.

Natural Resources Conservation (Permits and Licences) Regulations, 1996

Under the Permits and Licences Regulations (1996), a permit is required to carry out "any enterprise, construction or development of a prescribed description or category" anywhere in Jamaica and its Territorial Sea. Under the Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order, 1996, prescribed categories of "enterprise, construction or development" include water treatment facilities; mining and mineral processing plants; solid waste treatment and disposal facilities; cemeteries and crematoria; hazardous waste removal, storage, transportation, treatment and disposal facilities, processing of agricultural waste; industrial projects – including chemical plants, petroleum production, refineries, storage and stockpiling, food processing plants, detergent and soap manufacturing, cement and lime production plants, paint manufacturing facilities, sites for the manufacture of pesticides

or other hazardous or toxic substances, and citrus, coffee, cocoa, coconut, sugar cane processing plants.

The Permits and Licences Regulations were amended in 2015, principally to remove the grandfathering clause of the 1996 Regulations.

A licence is required to:

a) "discharge on or cause or permit the entry into waters, on the ground or into the ground, of any sewage or trade effluent or any poisonous, noxious or polluting matter; or

b) construct, reconstruct or alter any works for the discharge of any sewage or trade effluent or any poisonous, noxious or polluting matter."

Currently there is no gold mining in Jamaica, but exploration for gold is in progress in Bellas Gate Area of St. Catherine, and the obligations related to artisanal and small-scale gold mining practices under the Minamata Convention may have to be considered.

The Natural Resources Conservation (Hazardous Waste) (Control of Transboundary Movement) Regulations, 2002

The transboundary movement of hazardous waste is dealt with by the Natural Resources (Hazardous Waste) (Control of Transboundary Movement) Regulations, 2002. These Regulations, under which a system of permit is established, give effect to some of the key provisions of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal of which the Government of Jamaica is a Party. The procedure under these Regulations is further guided by the User's Guide to the Natural Resources (Hazardous Wastes) (Control of Transboundary Movements) Regulation, 2002 issued by NEPA. Under regulation 2, hazardous waste is defined with reference to the matters set out in the First, Second and Third Schedule. In the First Schedule (which sets out the categories of wastes to be controlled) both mercury and mercury compounds are included.

Natural Resources Conservation (Wastewater and Sludge) Regulations, 2013

Limits for approximately forty (40) chemical parameters, including mercury, are set out in the Third Schedule of the Wastewater and Sludge Regulations, 2013. The regulations state the permissible mercury concentrations for Trade Effluent Limit (0.02 mg/L), National Treated Sewage Sludge Standard for Fully Treated Sewage Sludge that can be applied to Agricultural Land (maximum concentration of 0.045 mg/kg dry weight mass), and Standard for Solid Waste/Industrial Sludge Suitable for Landfill (based on leachate quality test results) (0.1 mg/L).

Natural Resources Conservation (Ambient Air Quality Standards) Regulations, 1996

The Natural Resources Conservation (Ambient Air Quality Standards) Regulations set out various air quality standards for components such as lead, sulphur dioxide, carbon, nitrogen dioxide and other such components.

Natural Resources Conservation (Air Quality) Regulations, 2006

The Natural Resources Conservation (Air Quality) Regulations provides the framework for regulating emissions from major and significant point sources. Under these Regulations, mercury is classified as a priority air pollutant, and limits are placed on allowable emissions for mercury and its compounds including mercury alkyl. Relevant facilities licensed under these regulations are mandated by conditions of their licence to undertake self-monitoring activities and report on emissions released. NEPA also monitors emissions.

The National Solid Waste Management Act, 2001

This Act establishes the National Solid Waste Management Authority (NSWMA) which is mandated to, *inter alia,* "take all such steps as are necessary for the effective management of solid waste in Jamaica to safeguard public health, ensure that the waste is collected, stored, transported, recycled, reused or disposed of, in an environmentally sound manner and promote safety standards in relation to such waste...". Solid waste is defined to include "medical and hazardous waste and –

a) refuse or sludge from a waste treatment facility, water supply plant, air pollution control facility and garbage;

b) commercial, mining or agricultural operations or domestic activities; and

c) any contained substance or object which is or is intended to be, or required by law to be, disposed of, but does not include ... (iii) industrial discharges from pipelines conveying such waste."

The Act requires every person who operates or wishes to operate a solid waste disposal facility, or who provides or wishes to provide solid waste collection or transfer services, or who otherwise manages solid waste, to apply for a licence from the NSWMA. The Minister of Local Government and Community Development is empowered to exempt categories of persons from this requirement. Licences are granted or refused based on inspections by the NWSMA and recommendations from the relevant agencies, for example, NEPA.

The NSWMA, after consultation with NEPA, is authorised to require the owner or operator of a sewage treatment plant, industrial waste treatment facility or other solid waste disposal facility that generates sludge to provide it with information about the operation of the facility. Failure to provide the information is a criminal offence. The NSWMA is also authorised to issue cessation orders in prescribed circumstances as well as enforcement notices. Appeals against enforcement notices can be made to an Appeal Tribunal established under the Act. Appeals against the decision of the NSWMA not to grant a licence, to suspend or revoke a licence, or the inclusion of certain terms and conditions in a licence can be made to the Minister. An authorised officer under the Act has power to enter any solid waste disposal facility, inspect any book or record, and seize and detain any equipment or other article reasonably believed to be used in contravention of the Act.

NSWA is currently developing hazardous waste regulations (to be done in accordance with the National Solid Waste Management Act) to deal with certain types of hazardous

waste (i.e. electronic waste).[14] This would also include the management of mercury-added electronic waste products.

The Act provides for several criminal offences and penalties. The NSWMA is authorised to institute legal proceedings against any person for an offence under the Act.

The Public Health Act, 1985

The Public Health Act establishes a Local Board of Health in each parish of Jamaica. In addition, the Act also establishes a Central Health Committee based in the Ministry of Health. The function of the Central Health Committee is to advise the Minister and the Local Boards on matters of public health. With the coming into force of the National Health Services Act in 1997, Jamaica was divided into four health regions with each region being managed by a Regional Health Authority.

Chemicals other than pesticides and petroleum are regulated by the Standards and Regulation Division (SRD) of the Ministry of Health. There is no specific legislative authority for the exercise of this function. However, the management of chemicals is seen as part of the wider public health function under the Public Health Act. The SRD receives applications and issues permits to importers and manufacturers of chemicals – industrial chemicals, consumer chemicals and fertilisers.

Public Health (Nuisance) Regulations, 1995

In exercising its regulatory function, the SRD relies heavily on the Public Health (Nuisance) Regulations, 1995 which define "nuisance" to include:

- "Dust, smoke, fumes, gases or effluvia emitting from any manufacturing process or caused by the carrying on of any trade or business or otherwise by the action of any person;
- The discharge of any sewage, industrial waste or any other noxious matter into the sea or any watercourse or onto any land; and

[14] See draft National Solid Waste Management Authority (Disposal of Hazardous Waste) (Electronic and Electrical) Regulations, 2018.

- Offensive smells, including the emission of noxious fumes, gases or powerful smells, as a result of agricultural, domestic or industrial processes or otherwise."

These Regulations prohibit an owner, occupier or other person from causing, permitting or aiding and abetting another person to cause or permit a nuisance on any premises. A Medical Officer of Health, a Public Health Inspector, other authorised person or the Local Board can serve a notice to the owner, occupier or other person to stop the nuisance or prevent its recurrence. Failure to comply with the notice is a criminal offence. Where the Local Board acts to stop the nuisance and/or prevent its recurrence, any expenses incurred by the Local Board are recoverable in a Court from the owner of the premises as a civil debt.

Other regulations under the Public Health Act include:

The Public Health (Garbage Collection and Disposal) Regulations, 1998

Under these Regulations, "garbage" is defined to include "refuse of any description, whether generated by domestic, commercial or industrial activity, and all forms of solid and liquid waste matter". These Regulations operate at the parish level, and the Local Board is charged with the responsibility of collecting and disposing of garbage.

The Public Health (Tourist Establishments) Regulations, 2000

Anyone who intends to or operates a tourist establishment must apply to the Medical Officer of Health for the parish for a health certificate for the establishment. Under these Regulations, "hazard" is defined to mean "any physical, chemical or microbiological or other agent which is likely to cause a health risk"; "hazardous material" is defined to include "gasoline, kerosene, fuel oil, explosives, pesticides, rodenticides, insecticides, herbicides, disinfectants and cleansers"; and "solid waste" is defined to mean "material or by-product, solid or semi-solid, generated by a tourist establishment". These Regulations are comprehensive covering, *inter alia*, the areas of food safety, safety and conduct of employees, water supply, medical and first-aid facilities, and solid waste management. Contravention of these Regulations constitutes a criminal offence punishable by a fine and/or imprisonment.

Occupational Health and Safety Act

The Occupational Health and Safety Act aims to provide for the health and safety of persons at work and for the health and safety in connection with the activities at work.

Under the Occupational Safety and Health Act, each workplace will be required to have an occupational safety and health policy that outlines the commitment of each organisation under the law. The standard health and safety policies developed by workplaces under this Act also assist in reducing the risk of exposure to mercury from occupational hazards.

Draft Pesticides and Hazardous Chemicals Act

The primary objective of the legislation is to create a legislative regime that addresses chemicals generally with a focus on hazardous chemicals.

Preliminary drafting instructions have been prepared for a Pesticides and Hazardous Chemicals Act under the 2017 National Quick Start Programme Trust Fund (QSPTF) Project. The proposed legislation is intended to address chemical management from the cradle to the grave serving as an omnibus chemical legislation to address issues such as prevention, response, liability and compensation, and safety. The legislation will also provide for:

- the effective management of toxic chemicals in Jamaica, the regulation of trade in toxic chemicals to ensure the environmental health of Jamaica and to conserve and protect the environmental health as well as to conserve and protect the natural environment; and
- the support of the chemicals-related conventions to which Jamaica is a Party.

Under the proposed draft legislation, an Authority shall be established to have jurisdiction over chemicals, with some exceptions.

Customs Act, 1941

Under section 39 of the Customs Act, the Minister is empowered to prohibit certain goods, including mercury-added products. Also, section 40 sets out a list of restricted items. Section 210 imposes a penalty for importing prohibited or restricted items.

The Standards Act, 1969

This Act establishes the Bureau of Standards Jamaica which is mandated under section 6 to "promote and encourage the maintenance of standardisation in relation to commodities, processes and practices". The Bureau has the power, *inter alia*:

a) "to make recommendations to the Minister (currently under the Ministry of Industry, Commerce, Agriculture and Fisheries) in respect of the formulation of specifications and the promulgation and application of standard specifications, and compulsory standard specifications;

b) to promote research in relation to specifications and to provide for the examination and testing of commodities, processes and practices".

Examples of existing standards are:

JS 1, 1992. The labelling of commodities. Part 15: The labelling of household chemicals.

JS 1, 1996. Part 17: The precautionary labelling of hazardous industrial chemicals.

The provisions of this act would be applicable to controlling the manufacture, import and export of mercury-added products.

The Trade Act, 1955

Under section 8(1), the relevant Minister has various powers including by order:

a) prohibiting absolutely the importation or exportation of goods of any class or description of goods from or to any country;

b) prohibiting the importation or exportation of goods or any class or description of goods from or to any country except under the Authority of a licence granted by the Minister.

By section 8(2), the Minister's power under section 8(1) regarding exportation, distribution, purchase or sale or price (as the case may be) is restricted where goods fall under the provision of the Sugar Industry Control Act, the Agricultural Produce Act, the Agricultural Marketing Act, the Coconut Industry Control Act, the Cocoa Industry Board Act and the Banana Board Act. There is no restriction of the Minister's power under section 8(1) in respect of the importation of goods.

Among the subsidiary legislation promulgated under the Trade Act are the following:

- The Trade Act (Prohibition of Importation) (Equipment Containing Chlorofluorocarbons) Order, 1998;
- The Trade (Prohibition of Importation) (Equipment Containing Chlorofluorocarbons) (Amendment) Order, 1998;
- The Trade (Restriction on Importation) (Chlorofluorocarbons) Order, 1999;
- The Trade (Prohibition of Importation) (Equipment Containing Chlorofluorocarbons) (Amendment) Order, 2002; and
- The Trade (Restriction of Importation) (Chlorofluorocarbons) (Amendment) Order, 2002.

Food and Drugs Act

The Food and Drugs Act regulates food, drugs and cosmetics and defines each of these categories.

Section 12 of the Food and Drugs Act contains a prohibition to the sale of cosmetic that has any substance that may cause injury to the health of the user when the cosmetic is used. This would be applicable to skin-lightening creams with mercury content above 1 ppm. Thus, the sale of skin-lightening creams in such circumstances is prohibited. However, Article 4.1 of the Minamata Convention on Mercury requires that appropriate measures be taken to prohibit the manufacture, import or export of mercury-added products listed in Part I of Annex A which includes skin-lightening creams with mercury content above 1 ppm. The Food and Drugs Act does not contain any provisions to pro-

hibit the manufacture, import or export of cosmetics. Regulation 40 provides that a person shall not sell, manufacture, import or distribute a drug unless the drug has been registered with the Ministry of Health. Regulation 41 goes on to provide that a permit is required for manufacturing drugs. Regulation 43 requires an import permit for drugs to be imported into Jamaica. These provisions do not apply to cosmetics.

In the Food and Drugs Regulations, a permit system is thus established for the manufacture, import or export of drugs, but this is not applicable to cosmetics. The Food and Drugs Regulations therefore needs to be amended to extend the permit system to the manufacture, import and export of cosmetics.

The Mining Act, 1947

Under the Mining Act, licences and leases for mining must be obtained before prospecting or mining minerals listed under the Act. In the case of bauxite, there are special incentives and a special tax/production levy regime for bauxite and alumina incorporated into the licences and leases granted under the Mining Act. Bauxite activities have been identified as sources of mercury releases and as such, the health and safety regulations under this Act would contribute to ensuring that mercury releases from bauxite mining operations are controlled and potentially reduced, as per the obligations under Article 8 and 9 of the Minamata Convention.

The Mining (Safety and Health) Regulations, 1977

These regulations set out comprehensive regulations dealing with, *inter alia*, explosives, materials storage and handling, air quality and personal protection.

The Quarries Control Act, 1983

The Act prohibits the opening, establishment or operation of a quarry for the purpose of extracting quarry material or mineral except under a licence issued by the Minister responsible for mining. The Commissioner of Mines, a Medical Officer or other authorised person is empowered “at all reasonable times to enter, inspect and examine any premises or land on which a quarry is being operated or where quarried material or quarried mineral is stored...”. If such person finds “any quarry to be operated in a dangerous or

defective manner...", he must give a notice in writing to the person operating the quarry requiring that remedial action be taken. Failure to comply constitutes a criminal offence. The Quarries Control Regulations, 1958[15] sets out comprehensive regulations dealing with, *inter alia,* safety, health and welfare of workers and with explosives. These regulations would also contribute to ensuring the health and safety of workers who may be exposed to mercury during quarrying bauxite operations.

The Clean Air Act, 1961

This Act empowers an inspector to "enter any affected premises at any time while work is being carried on there, or while there is any discharge of smoke or fumes or gases or dust into the air from any part of such premises...", inspect and examine the premises, make enquiries, and make tests and take samples of any substance, smoke, fumes, gas or dust as necessary.

The owner, including a leasee or occupier, of affected premises is required to "use the best practicable means for:

a) preventing the escape of any noxious or offensive gas;

b) preventing the discharge of any such gas into the air; and

c) rendering such gas, where discharged, harmless or inoffensive..."

"Affected premises" is defined in the Act to mean "any premises on which there are industrial works, the operation of which is in the opinion of an inspector likely to result in the discharge of smoke or fumes or gases or dust into the air." Breach of this Act constitutes a criminal offence punishable by a fine and if in default of payment, by imprisonment.

The Schedule lists the noxious or offensive gases to which the Act applies as:

[15] These Regulations were made under the Quarries Act (now repealed) and were saved by section 35(2) of the Quarries Control Act, 1983.

- Fumes or dust emanating from any works to produce alumina;
- Fumes or dust from any cement works;
- Fumes or dust from any lime works;
- Gas containing any sulphur compound emanating from any petroleum works;
- Fumes, vapour, or gas from any electrical generating station;
- Fumes or dust from any gypsum works; and
- Ash, dust or soot from any sugar factory.

This Act is administered by the Central Committee of Health established under the Public Health Act.

3.2.2 Minamata Convention and Jamaican Legislation

This section highlights those Articles of the Minamata Convention on Mercury that are covered under existing national legislation (Table 27).

Table 27: Overview of relevant Minamata Convention provisions, coverage and gaps by existing legislation in Jamaica

Article and Paragraph	Summary of Provisions	Summary of Assessment	Legislative and Policy Actions Needed to Address Gaps
2	Provides relevant definitions including for "mercury-added products"	No such definitions are currently in any legislation or policy.	This definition will need to be added to any relevant legislation which is to be enacted or amended.
3 (3)	Restriction on new primary mercury mining	Primary mercury mining does not occur in Jamaica; therefore, this article is not applicable to the implementation of the Convention.	N/A
3 (4)	Phase out of existing primary mercury mining	Primary mercury mining does not occur in Jamaica; therefore, this article is not applicable to the implementation of the Convention.	N/A
3 (5) lit. (a)	Identification of mercury stocks exceeding 50 metric tons, as well as sources of mercury supply generating	There is no legislation addressing this activity. In Jamaica, by-product mercury from the bauxite mining and production processes may result in mercury supply generating	Results of the inventory conducted under this project have determined that this is not applicable to Jamaica.

Article and Paragraph	Summary of Provisions	Summary of Assessment	Legislative and Policy Actions Needed to Address Gaps
	stocks exceeding 10 metric tons per year.	stocks that need to be identified.	
3 (6)	Restriction on mercury exports	There is no existing legislation that restricts the export of mercury from Jamaica. This article is also not applicable to the country as mercury exports were determined to be negligible.	N/A
3 (8)	Restriction on mercury imports	There is no existing legislation that specifically restricts the import of mercury into Jamaica. The Pesticides Act, however, restricts the importation of pesticides containing mercury. An import ban could be imposed under Section 8 of the Trade Act, if deemed necessary in the future.	Establish a ban on mercury imports through the Trade Act, if deemed relevant. (Note: this refers to mercury and its compounds, not mercury-added products)
4	Prohibition of manufacture/import/export of certain mercury-added products (Annex A, Part I) and Measures with respect to other products such as dental amalgam (Annex A, Part II)	This can be complied with by acting under section 39 of the Customs Act to prohibit the import or export of mercury added products listed in Part I of Annex A (the requirement to prohibit these goods would come into effect on the phase out date, i.e. 2020). In addition, section 40 of the Customs Act provides for a list of restricted items. The Trade Act also could be utilised to place mercury-added products listed in Part I of Annex A of the Convention on the Negative List for importation or exportation. With respect to Annex A Part II products, there is no existing legislation regarding dental amalgam, however, the Ministry of Health has a policy in place to phase-out the use of dental amalgam. Standards could be developed and enforced to discourage the distribution of new mercury-added products.	Prohibit the import and export of mercury-added products through the Customs Act and Trade Act. Review and revise, as appropriate, the Ministry of Health's Policy to ensure the phase down of the use of dental amalgam. The Minamata Convention Annex A Part II lists several recommendations which can be incorporated for phasing down dental amalgam and stipulate that Parties should include at least two of those recommendations in their implementation measures.
5	Prohibits the use of mercury or mercury compounds in the	None of the processes listed in Part I and II of Annex B occur in Jamaica, and this article is not	Not currently applicable; however, if in the future such processes become

Article and Paragraph	Summary of Provisions	Summary of Assessment	Legislative and Policy Actions Needed to Address Gaps
	manufacturing processes listed in Part I of Annex B of the Convention except where the party has a registered exemption pursuant to Article 6. It also requires that Parties take measures to restrict the use of mercury or its compounds in the processes listed in Part II of Annex B of the Convention.	applicable.	relevant, they would be regulated under the Natural Resources Conservation (Permits and Licences) Regulations, 1966. Further, an entity which conducts a manufacturing process would also have to comply with the Occupational Safety and Health Act which provides for health and safety of persons at work and for health and safety in connection with safety at work.
7 (2)	Reduce/eliminate emissions from Artisanal and small-scale gold mining (ASGM).	Permission has recently been given for gold exploration in the Bellas Gate, St. Catherine area. If gold mining operations do begin it is not expected that the types of gold deposits in Jamaica would utilise mercury in the extractive metallurgical process.	Ensure that gold mining practices use mercury-alternative methods.
8 (3)	Controlling emissions: Develop a national plan (optional)	Waste incineration facilities and cement production facilities fall under this article. While coal-fired industrial boilers and power plants are not currently operational, they are listed as a permitted activity. Under the NRCA (Air Quality) Regulations, emissions should be monitored by the facility as well as NEPA.	A National Plan can be developed to set annual standards for emissions from such facilities and put measures in place to monitor emission controls and implement steps to reduce these emissions.
8 (3)/8 (4)	Required BAT/BEP for new sources	This is covered to some extent under the NRCA (Air Quality) Regulations as licenced facilities are required to take steps to reduce emissions if they exceed limits set out.	Require the use of best available technologies and best environmental practices for all new emission sources and where appropriate for existing emission sources of mercury and mercury compounds.
8 (3)/8 (5)	Emission control measures for existing sources	NRCA (Air Quality) Regulations and the National Ambient Air Quality Standards do not fully address the requirements of Article 8 but amendments to these documents are under consideration by NEPA. The measures outlined in Article 8(5)	Set emission control standards and enforce the use of best available technologies and best environmental practices by release sources and incorporate into national plans.

Article and Paragraph	Summary of Provisions	Summary of Assessment	Legislative and Policy Actions Needed to Address Gaps
		that can be included in any national plans should be considered in order to ensure the requirements of Article 8 are met.	Implement legislation that addresses monitoring and evaluation of emissions sources.
8 (7)	Establish emissions inventory	Under the NRCA (Air Quality) Regulations, NEPA is responsible for developing a National Emissions Inventory to track air quality within identified air sheds and emissions; and make the inventories available to the public and the relevant Minister. The last publicly available report to date is from 2012.	Encourage data sharing to establish up-to-date and accurate emission inventories.
9 (3)	Identify relevant sources for releases (to water and land)	Under the MIA project, this was conducted using the UN Environment Toolkit for Identification and Quantification of Mercury Releases. Several gaps were found which should be addressed in future analysis.	Conduct additional analyses to identify and quantify relevant sources of release
9 (4)	Releases control	Under the Natural Resources Conservation (Wastewater and Sludge) Regulations, 2013, limits for mercury in trade effluent and sewage sludge are set. As these limits were developed in alignment with best environmental practices to control such releases, the obligation under Article 9 for this output pathway has been met. Releases to pathways other than wastewater and sludge should be implemented under the NRCA Act.	Set mercury discharge standards for remaining output pathways and enforce the use of best available technologies and best environmental practices by release sources. Implement legislation that addresses monitoring and evaluation of release sources.
9 (6)	Establish release inventory	Under the MIA project, this was conducted using the UN Environment Toolkit for Identification and Quantification of Mercury Releases. Several gaps were found which should be addressed in future analysis.	Encourage data sharing to establish accurate release inventories.
10	Environmentally sound interim storage of mercury, other than waste mercury	This article applies to interim storage for mercury and mercury compounds identified in Article 3, which have been determined	Not currently applicable. However, if it becomes applicable in the future, the Natural Resources

Article and Paragraph	Summary of Provisions	Summary of Assessment	Legislative and Policy Actions Needed to Address Gaps
		to be irrelevant in Jamaica.	Conservation (Permit and Licences) Regulations, 1996 which incorporated the stipulations of the Basel Convention may be relevant. It is also necessary to educate relevant stakeholders on safe practices for storage of non-waste mercury.
11	Mercury waste	Legislation is not in place to address the environmentally sound management of mercury wastes specifically. Mercury waste from the bauxite industry is managed in an environmentally sound manner. Article 11 also states that thresholds may be developed for mercury wastes. Current legislation does not provide for the implementation of thresholds. The obligations of Article 11 will be developed in accordance with guidelines under the Basel Convention to which Jamaica is a Party. The Basel Convention does address the environmentally sound management of this type of hazardous waste and the Natural Resources (Hazardous Waste) (Control of Transboundary Movement) Regulations, 2002 gives effect to the provisions of the Basel Convention.	Develop environmentally sound interim storage and treatment facilities for waste mercury. Educate stakeholders on safe and environmentally sound disposal practices for waste mercury. Review the Natural Resources (Hazardous Waste) (Control of Transboundary Movement) Regulations, 2002 to determine if all aspects of the Basel Convention guidelines and Article 11 of the Minamata Convention are adequately incorporated.
12	Contaminated sites	There is currently no legislation specially governing the management of sites contaminated with mercury and mercury compounds. Under the MIA project, a model to assist the Government in the assessment of potentially contaminated sites has been	Establish mechanisms to assess and remediate contaminated sites. Also, the management of sites contaminated with mercury and mercury compounds will be guided by the Minamata Convention's Technical Guidelines on managing

Article and Paragraph	Summary of Provisions	Summary of Assessment	Legislative and Policy Actions Needed to Address Gaps
		developed.	contaminated sites, once finalised and adopted by the Convention.
16	Health aspects	There are diverse legal acts, including the Public Health Act and Regulations and the Occupational Health and Safety Act, 2017, aimed at protecting the general public, vulnerable groups, and workers. These include legislation addressing: • Water; • Drinking water; • Food safety; • Public Health; and • Occupational health and safety.	Promote awareness on the hazards of mercury exposure. Identify populations at risk and put measures in place to reduce the risk to these groups. Promote safe handling techniques and ensure the use of relevant safety equipment for workers exposed to mercury releases and emissions.

3.2.3 Changes to be made to enforce the Articles of the Convention that are relevant to Jamaica.

Article 4: Part I of Annex A of the Minamata Convention sets out the phase-out dates for manufacture, import or export of mercury-added products. The phase-out date specified in Part I of Annex A is 2020.

The phase-out for the products set out in Part I of Annex A can be dealt with by existing legislation as follows:

Trade Act, 1955

Under section 8(1) of the Trade Act the relevant Minister has various powers including by order to:

a) prohibit absolutely the importation or exportation of goods of any class or description of goods from or to any country;

b) prohibit the importation or exportation of goods or any class or description of goods from or to any country except under the Authority of a licence granted by the Minister.

Among the subsidiary legislation promulgated under the Trade Act are those related to the prohibition on the importation of chlorofluorocarbons.

Similar to how the Trade Act has been used to restrict the importation of chlorofluorocarbons, it could equally be used to prohibit the importation or exportation of the items specified in Part I of Annex A of the Convention. No legislative amendment is necessary. The Minister acts under section 8 by virtue of a Ministerial Order. The relevant Ministry responsible for the Minamata Convention would have to consult with Ministry responsible for Trade to request that he/she exercises the powers under section 8 of the Trade Act.

Food and Drugs Act and Regulations

Section 12 of the Food and Drugs Act prohibits the sale of cosmetics where such cosmetics contains any substance that may cause injury to the health of the user. Thus, under section 12, skin-lightening products and other cosmetics containing mercury could be prohibited. However, neither the Food and Drugs Act, nor the Food and Drugs Regulations deals with the manufacture, import or export of cosmetics (though these Regulations do address the manufacture, import and export of drugs).

The gaps in the Food and Drugs Act and Regulations include the absence of specific clear provision controlling the import or export and manufacture of cosmetics.

The Food and Drugs Regulations would need to be amended to regulate the manufacture, import and export of cosmetics.

Standards Act

The Standards Act would be relevant to the manufacture of skin-lightening creams. Under the Standards Act, national standards could be established for the manufacture of skin-lightening creams. The Ministry responsible for the Minamata Convention would

have to formally request that the Bureau of Standards establishes national standards for such cosmetics. The Bureau of Standards would follow their usual procedure for developing and issuing standards through their Technical Committees and consultations. Where there are applicable international standards, the Bureau of Standards could adopt the international standards subject to formal consultations with relevant personnel.

Section 13 of the Food and Drugs Act also contemplates the establishment of national standards for cosmetics. Such standards would be made under the Standards Act.

New legislation would not be required to regulate cosmetics (with mercury content above 1ppm), including skin-lightening soaps and creams, as a new national standard can be issued in accordance with the Standards Act. Thus, where national standards for cosmetics (in this case skin lightening creams) have been promulgated, the Standards Act could be relevant to the manufacture of skin-lightening creams. The existing statutory provisions of the Standards Act would be sufficient to promulgate the required national standards.

Customs Act

Under section 39, the Minister responsible for Customs may prohibit the importation or exportation of goods specified in an Order issued by the Minister subject to any specified conditions.

Sections 40(i) to 40(xxi) specifies goods that are to be prohibited. Mercury or mercury products are not listed among the goods set out in these sections. However, section 40(xxii) extends the prohibition to “such other articles not herein before mentioned, the importation of which is prohibited or may be prohibited from time to time by law.”

Under section 39 of the Customs Act, the Minister may impose an import prohibition on certain goods. An example of this is the Customs (Import Prohibition) (miscellaneous

Goods) (no. 2) Order 2010. No new legislation is needed to implement the provisions of Annex A of the Convention if the powers under section 39 of the Customs Act are utilised by the Minister. The Minister can make an Order under section 39 to prohibit the import of the items set out in Part I of Annex A.

The relevant institutions under Article 4 would be the Minister responsible for Trade (under the Trade Act), Minister responsible for Finance (under the Customs Act), Bureau of Standards (Standards Act), Ministry of Health (Food and Drugs Act and Regulations).

Article 6: This Article pertains to exemptions available to a Party upon request. A country may register for one or more exemptions from the phase-out dates listed in Annex A and Annex B on becoming a Party or in the case of any mercury-added product that is added by an amendment to Annex A.

It is important to note that a country officially becomes a Party to the Convention on the ninetieth day after the date of deposit of its instrument of ratification, acceptance, approval or accession. As Jamaica did not apply for any exemptions upon submitting its instrument of ratification or within ninety days of submitting its instrument of ratification, the phase out dates of Article 4 (Part I, Annex A) are obligatory.

It should be noted that Jamaica on submission of its instrument of ratification indicated that any amendment to any Annex of the Convention would only apply to it when it had deposited its instrument of ratification, acceptance, approval or accession.

Article 8: This Article deals with controlling and where feasible, reducing emissions of mercury and mercury compounds to the atmosphere through measures to control emissions from point sources falling within the source categories listed in Annex D. The point sources under Annex D includes coal-fired power plants, waste incineration facilities and cement clinker production facilities.

Jamaica promulgated the Air Quality Standards in 1996 (Natural Resources Conservation Authority (Ambient Air Quality Standards). Subsequently, in 2006, the Natural Resources Conservation Authority (Air Quality) Regulations were promulgated to control air pollution from major and significant facilities. By Regulations 4(1) every operator of a major facility or significant facility shall apply for an air pollutant discharge licence.

Under the Air Quality Regulations air pollutants are divided into “criteria air pollutant” and “priority air pollutant”. Under section 2 of these Regulations “criteria air pollutant” means a pollutant to which ambient air quality standards apply. However, mercury and mercury compounds are not included in the definition of criteria air pollutant. “Priority air pollutant” means an air pollutant included in the list of priority air pollutants set out in the Second Schedule. Mercury air pollutants are included in the list of priority air pollutants.

In Jamaica, the relevant point sources identified in the inventory that are included under Annex Dare cement production facilities and waste incineration facilities. It is noted that while coal-fired industrial boilers and power plants are not operational in Jamaica, they are listed as permitted activities. All listed point sources would be regulated under the NRCA. The cement company in Jamaica has an air pollutant discharge licence. Although not regulated under Article 8, all bauxite companies also have air pollutant discharge licences. When a licence is granted, NRCA may impose requirements for periodic or continuous stack monitoring, performance or compliance testing, ambient and meteorological monitoring and such other measures to maintain or improve ambient air quality as the Authority thinks fit. Under Regulation 4, NRCA could impose specific conditions for the emissions of mercury in the air.

Under a Memorandum of Understanding (MOU) with the Jamaica Bauxite Institute, the Institute monitors environmental permits and licences issued by the NRCA in the bauxite sector and reports the monitoring results to the NRCA. In execution of the MOU, JBI also generally monitors environmental management issues on behalf of NEPA in the bauxite sector.

As part of the process of implementing the air quality regulatory mechanism NEPA in 2010 prepared the Jamaica Air Quality Management Programme (JAQMP). The JAQMP addresses the licensing of facilities in Jamaica as well as establishing a national air monitoring network that measures criteria pollutants to support analysis of air quality parameters and health effect studies. The JAQMP points out that although air quality regulations are in effect in Jamaica, capacity needs to be built for the review and processing of application for licensing and the monitoring and enforcement of conditions in the licences granted. Currently NEPA is working on a revised JAQMP which would likely be a 5-year plan for air quality management. The revised JAQMP will strengthen existing gaps and set new benchmarks. The revised JAQMP would provide a road map for the capacity development needs for an effective air quality management programme, in addition, seeks to strengthen the enforcement and monitoring capacity of NEPA.

Compliance with the NRCA Ambient Air Quality Standards Regulations accompanied by stringent enforcement will address both the major and significant industrial air pollution sources.

No new legislation is needed to implement the provisions of Article 8.

Article 9: This Article relates to controlling and where feasible, reducing releases of mercury and mercury compounds, to land and water from relevant point sources.

The discharge of waste into land or water is governed by the Natural Resources Conservation (Permits and Licences) Regulations, 2015 and the Natural Resources Conservation (Wastewater and Sludge) Regulations, 2013.

Waste produced from the bauxite sector from the processing of alumina from bauxite would be governed by the Natural Resources Conservation (Permits and Licences) (Amendment) Regulations, 2015 at paragraph 19 of the Second Schedule (Waste Processing and Disposal).

No new legislation would be needed to implement the provisions of Article 9. Considerations may be made for the development of a national plan to set out measures to be taken to further control releases with expected targets, goals and outcomes. The results of the mercury inventory conducted under the MIA Project may inform this. If the Government of Jamaica develops such a plan, it should be submitted to the Conference of the Parties within four years of becoming a Party and considerations may also be made to amend relevant regulations to incorporate measures detailed in the national plan.

The Convention has also adopted BAT and BEP Technical Guidelines.

Jamaica, as a Party to the Minamata Convention, shall require the use of Best Available Techniques (BAT) and Best Environmental Practices (BEP) to control, and where feasible, reduce emissions from the relevant new sources listed in Annex D of the Convention by no later than 5 years after entry into force of the Convention for the country. This requirement could be included in the permit conditions for new facilities. There are also stipulations for existing emission sources as per Article 8(5) of the Convention.

Article 11 – refers to the environmentally sound management of mercury wastes.
The Natural Resources Conservation (Permits and Licences) (Amendment) Regulations, 2015 (PRR 51 of 2015) revised the list of activities for which permits are required. At paragraph 21 (Waste Processing and Disposal), a permit is required for, *inter alia*, “Construction and operations of hazardous waste, removal, storage, transportation, treatment or disposal facility (mobile and fixed)”.

Thus, once hazardous waste falls under paragraph 21, the management of hazardous waste would be governed by the provisions of the Natural Resources Conservation (Permits and Licences) Regulations, 2015. Regulation 3 governs the process of applying for a permit. Under Regulation 7D, NRCA may modify or vary the terms and conditions of a permit where it determines that a material change of circumstances occurred since the permit was first granted.

The Permits and Licences Regulations list the activities that require a permit. Where a permit is required, the conditions attached to the permit could address soil remediation if required.

Due to the lack of a hazardous waste disposal site, the NSWMA receives on request, specific hazardous waste streams, namely asbestos and electrical and electronic waste for which the agency has environmental permits for their storage.

In the event of contamination of the land or if there is a pollution incident that involves hazardous material/waste, a contamination assessment would be required. NEPA would advise on the remediation requirements, if any, that should be done. Where a situation demonstrates a serious threat, an Enforcement Notice under section 18 of the Natural Resources Conservation Authority Act would be an available enforcement measure.

Under section 18 of the Natural Resources Conservation Authority Act where it appears to the Authority that the activities of an undertaking in any area are such as to pose a serious threat to natural resources or to public health, the Authority may serve an enforcement notice to the person who appears to have carried out or to be carrying out the activity. The Enforcement Notice would involve specifying the offending activity and the steps to be taken within the specified time to ameliorate the effects of the activity and where appropriate to restore the natural resources to their condition before the activity took place. The Enforcement Notice could provide for a contamination assessment, sampling, lab results and a remediation plan.

The transboundary movement of hazardous waste is governed by the Natural Resources (Hazardous Waste) (Control of Transboundary Movement) Regulations, 2002 which seeks to implement the Basel Convention of which Jamaica is a Party.

The NSWMA has prepared draft regulations to address a specific category of hazardous waste. The National Solid Waste Management Authority (Disposal of Hazardous

Waste) (Electronic and Electrical) Regulations, 2018. The Schedule of the draft regulations covers different categories of e-waste (e.g. Household appliances, computers etc.).

In the Fourth Schedule of these Regulations, the disposal of components containing mercury such as electrical switches would also require a licence. It is expected that these draft Regulations will become effective later this year. An expanded Regulation to take into consideration some of the mercury-added products listed under Annex A, Part I would facilitate the implementation of Article 11.

Consideration should also be given to the incorporate of threshold limit values for mercury wastes based on best environmental practices to address any threshold values that may be developed at future Conference of the Parties for the Basel and Minamata Conventions.

Apart from the promulgation of the National Solid Waste Management Authority (Disposal of Hazardous Waste) (Electronic and Electrical Waste) Regulations no additional legislation is necessary to implement Article 11.

Article 12 – Article 12 provides that each Party shall endeavour to develop appropriate strategies for identifying and assessing sites contaminated by mercury or mercury compounds. Article 12 is a permissible provision as the use of the word "shall endeavour" would indicate that it is not legally binding.

Where there are contaminated sites, the Guidelines for the Preparation of Remediation Planning, 2015 prepared by NRCA would be applicable. The Guidelines (at p. 1) states-

> "contaminated land and water pose significant risk to human health, and/or the wider environment. As such the need for thorough remediation arises. Remediation of contaminated sites refers to the removal or encapsulation of contaminated substances from various media, such as oil, soil and water, in

hopes of restoring certain parameters to pre-release levels and/or removing/reducing the adverse risk to humans and surrounding circumstances"

The Guidelines provide directions on the required content of Remediation Plan for the clean-up of contaminated sites. In particular, the Guidelines provides detailed instructions on what should be included in a Remediation Plan and how the information should be presented.

In circumstances, therefore, where a site is contaminated the Guidelines are to be followed for the preparation of a remediation plan, which is then submitted to NEPA for review. On being deemed adequate to address the incident at hand an approval for the plan would be granted by NEPA, and the remediation undertaken to the approved plan.

No new legislation is needed to implement Article 12.

Article 16: The Article refers to the health aspects associated with mercury and mercury compounds. The recommendations provided within this article are not obligatory for Parties.

The organisations that would lead in the implementation of Article 16 would be-

- the Ministry responsible for Health (Article 16(1)(a), 16(1)(c), 16(1)(d))
- the Ministry responsible for Labour (Article 16(1)(b))
- the Ministry responsible for Education (Article 16(1)(b))
- the Ministry responsible for Science, Energy and Technology (Article 16 (1)(a), 16(1)(b))

The key coordinating agency for the implementation of Article 16 would be the Ministry responsible for Health.

Article 16 activities could include-

- Adopting science-based guidelines relating to the exposure of mercury and mercury compounds.
- Setting targets for mercury exposure or reduction, where appropriate.
- Public education, with the participation of environmental health etc.

No legislation is required to implement Article 16.

3.2.4 Gaps

There are several gaps in Jamaica's existing legislation regarding mercury and its environmentally sound management. The main gaps include:

1. Orders to be issued under the Trade Act and/or Customs Act to include the ban on import and exports of mercury-added products listed under the Minamata Convention.
2. Mercury releases to land and water other than through trade effluent or sewage sludge are not addressed by any regulations.
3. There are no regulations in place regarding storage capacity for the permanent or short-term storage of mercury waste.
4. The lack of any statutory provision in the Food and Drugs Act or the Food and Drugs Regulations to regulate the manufacture, import or export of cosmetics.

3.2.5 Summary of Legislative Recommendations

Short- and medium- term recommendations were determined to fill the identified legislative gaps and to promote environmentally sound mechanisms for mercury management in Jamaica (Table 28).

Table 28: Legislative Recommendations for Jamaica

Implementation time frame	Recommendation
Short Term **(6 *to 12 months*)**	• Ensure enforcement of emissions and releases controls under the relevant regulations under the National Resources Conservation Act. • Promulgate the National Solid Waste Management Authority (Disposal of Hazardous Waste) (Electronic and Electrical Waste) Regulations

Medium Term **(*12 to 18 months*)**	Amend the Food and Drugs Regulations to establish a permit system for the manufacture, import and export of cosmetics with mercury content above 1 ppm.
	• The Ministry of Industry, Commerce, Agriculture and Fisheries should ban/restrict the import of mercury and mercury compounds through the Trade Act. • The Minister responsible for finance to exercise the powers under section 39 of the Customs Act to ban the import of mercury and mercury compounds (as listed in I, Annex A of the Minamata Convention)

3.3 Assessment of Institutional Framework

3.3.1 Key Institutions

The management of chemicals and particularly, mercury, falls primarily under seven (7) Ministries of the Jamaican Government.

1. **The Ministry of Health (MOH)** is the main Government organisation whose mandate is "To ensure the provision of quality health services and to promote healthy lifestyles and environmental practices". The Ministry, together with its Regional Health Authorities (RHAs), Agencies and related organisations make up the public health system and are responsible for health care delivery across the island.

   The MOH has responsibility for all chemicals (except petroleum) throughout their life cycle. *The Standards and Regulation Division (SRD), the Environmental Health Unit* within the Ministry and the *Pesticides Control Authority (PCA),* a statutory body within the ministry, are directly involved in carrying out this function.

   The Ministry of Health would also have overarching responsibility for measures to be implemented under Article 16.

2. **The Ministry of Economic Growth and Job Creation (MEGJC)** is charged with drafting the blueprint to drive economic growth and sustainable development in Jamaica. The Ministry has responsibility for seven (7) critical portfolio areas.

They are: Land, Environment, Climate Change, Investment, Water and Wastewater, Housing and Works. Under its portfolio areas, the Ministry has oversight for some forty-eight (48) Agencies, Departments and Divisions, which are responsible for approximately sixty-eight (68) subject areas.

The *National Environment and Planning Agency (NEPA),* which includes the Natural Resources Conservation Authority falls under this Ministry and its mission is to promote sustainable development by ensuring protection and management of the environment in Jamaica. It is the environmental management (monitoring, pollution control and planning) agency and it is also responsible for the transboundary movement of hazardous waste.

3. The **Ministry of Local Government and Community Development (MLGCD)** has a mission to provide a sound policy, legal, technical and administrative framework that supports excellent service delivery and operational management by the Local Authorities and portfolio agencies, in a manner that advances the ideals of effective local governance and the goals of sustainable, community development, through a purpose-driven and competent workforce. The MLGCD has the mandate to manage solid waste in Jamaica through its National Solid Waste Management Authority (NSWMA). The NSWMA will have a direct role in the storage and disposal of mercury in Jamaica.

4. The **Ministry of Science, Energy and Technology** is responsible for the petroleum industry in Jamaica. The Petroleum Corporation of Jamaica established under the Petroleum Act, 1979 is charged with managing Jamaica's fuel needs.

5. The **Ministry of Transport and Mining**, in respect to mining, has responsibility for:

    a) Clarendon Alumina Production Limited
    b) The Jamaica Bauxite Institute (JBI)
    c) The Jamaica Bauxite Mining Company and;
    d) The Mines and Geology Division.

The *Jamaica Bauxite Institute (JBI)* oversees the regulation of environmental standards in the industry, which includes pollution control initiatives, independent monitoring of the industry, community relations and public education, with regular reporting on the environmental performance of the Industry to NEPA. JBI is responsible for conducting regular environmental reviews at each of the bauxite companies' operations, in collaboration with other relevant government organisations, such as the Water Resources Authority (WRA).

The *Mines and Geology Division* has the statutory responsibility under the Mining Act and the Quarries Act to exercise general supervision over all prospecting, mining and quarrying operations throughout the island. The Division also manages the investigation, characterisation, documentation and release of information on all aspects of geology in Jamaica. The Mines and Geology Division is the Government organisation responsible for dealing with the application (if any) for gold and base metal mining.

6. **The Ministry of Industry, Commerce, Agriculture and Fisheries** is the ministry under which the *Bureau of Standards Jamaica (BSJ)* falls.

The BSJ was established by the Standards Act of 1968 to promote higher standards in commodities, processes and practices. The BSJ also administers the Processed Food Act and the Weights and Measures Act. A Standards Council is responsible for policy decisions, and an Executive Director for the general administration of the organisation.

Standards for development activities, facilitated by the BSJ, are carried out by some 18 technical committees covering a wide range of fields in industry.

Some of the key areas of involvement by the BSJ are- standards development (national, regional and international standards) conformity assessments under the Standards Act, the Weights and Measures Act and the Processing Food Act in the areas of inspection, testing, certification, laboratory accreditation, monitoring, registration, metrication, metrology, advisory, training and testing services, compliance/import, monitoring programme, providing technical information to manufacturers, exporters, traders, etc.

The BSJ also serves as the WTO/TBT, Codex Alimentarius Commission Contact Point.

7. The **Ministry of Finance** is the ministry under which the *Jamaica Customs Agency* falls.

The Jamaica Customs Agency (JCA) is mandated to ensure the equitable collection of revenue, the protection of Jamaica's borders against illicit imports and the facilitation of trade. The JCA's activities include protecting Jamaica's industries, labour and intellectual property rights by enforcing Jamaica's laws intended to prevent illegal trade practices, including provisions related to quotas; protecting the general welfare and security of Jamaica by enforcing import and export restrictions and prohibitions, among other responsibilities. All customs activities are governed by the Customs Act. In addition to its own laws, the JCA enforces over 125 other provisions of law for other agencies.

3.3.2 Key Government Institutions and Implementation of the Minamata Convention

Table 29 summarises the main government bodies that would be responsible for overseeing the actions for the implementation of the provisions of the Minamata Convention identified in Section 3.2.2 of this report.

Table 29: Overview of Minamata Convention provisions, required action and potential lead government institution in Jamaica

Article and Paragraph	Summary of Provisions	Legislative and Policy Actions Needed to Address Gaps	Government Institution to Oversee Action
3 (5) lit. (a)	Identification of mercury stocks which exceed 50 metric tons, as well as sources of mercury supply generating stocks exceeding 10 metric tons per year.	Based on the existing inventory, there are no such stocks located within Jamaica's territory. Further assessments may be carried out if deemed necessary.	NEPA, JBI Mines and Geology Division
4 (1)	Prohibition of manufacture/import/export of certain mercury-added products (Annex A, Part I)	Prohibit the import and export of mercury-added products through the Trade Act. Prohibit the manufacture of mercury-added products through the Standards Act.	NEPA Jamaica Customs Agency Ministry of Health Bureau of Standards Jamaica Trade Board/ Ministry with responsibility for industry and commerce
4 (3)	Measures with respect to dental amalgam (Annex A, Part II)	Review the Ministry of Health Policy to ensure the phase down of the use of dental amalgam in accordance with at least two of the measures listed in Annex A Part II of the Convention.	Ministry of Health
5 (7)	Discourage "the development of new facilities using any other mercury-based manufacturing process"	Develop legislation that discourages the development of new facilities listed in Annex B of the Minamata Convention, if deemed necessary.	MEGJC NEPA Ministry of Labour and Social Security Attorney General's Chambers
6	Application for an	Notify the Secretariat to the	MEGJC

Article and Paragraph	Summary of Provisions	Legislative and Policy Actions Needed to Address Gaps	Government Institution to Oversee Action
	exemption for phase-out dates listed in Annex A or B should an amendment to the Annexes occur	Minamata Convention in writing to request exemption from phase out dates should an amendment to Annex A or B occur. The guidance for applying for such exemptions is provided on the Minamata Convention website. Any requests must be submitted by the Convention's Focal Point no later than the date of the amendment entering into force.	
7 (2)	Reduce/eliminate releases from Artisanal and small-scale gold mining (ASGM).	Ensure the use of mercury-free methods in the potential ASGM activities	NEPA Ministry of Labour and Social Security Ministry of Transport and Mining (Mines and Geology Division)
8 (3)	Controlling emissions: Develop a national plan (optional)	If deemed necessary, develop a national plan to further monitor emissions from the relevant source categories listed in Annex D of the Convention. If done, the national plan must be submitted to the Conference of the Parties no later than four years after becoming a Party	NEPA MEGJC
8 (3)/8 (4)	Required BAT/BEP for new sources and where deemed appropriate for existing sources	Require the use of best available technologies and best environmental practices by all sources of mercury.	NEPA
8 (3)/8 (5)	Emission control measures for existing sources	Ensure the enforcement of the NRCA Air Quality Regulations and regular monitoring and evaluation occurs.	NEPA
8 (7)	Establish emissions inventory	Encourage up-to-date data sharing to establish accurate emission inventories.	NEPA
9 (3)	Identify relevant sources for releases (to water and land)	Promote testing of potential mercury release sources to identify relevant sources of release.	NEPA
9 (4)	Releases control	Ensure the enforcement and regular monitoring and evaluation of the standards set out under the NRCA Wastewater and Sludge Regulations. Identify gaps in analysis of mercury releases to land and water and determine if more detailed mercury standards	NEPA

Article and Paragraph	Summary of Provisions	Legislative and Policy Actions Needed to Address Gaps	Government Institution to Oversee Action
		should be set.	
9 (6)	Establish release inventory	Encourage data sharing to establish accurate release inventories.	NEPA
11 (3)	Mercury waste	Identify stockpiles and develop environmentally sound interim storage and treatment facilities for waste mercury. Educate stakeholders on safe and environmentally sound disposal practices for waste mercury. Transboundary movements of mercury waste must under-taken in keeping with the provisions of The Natural Resources (Hazardous Waste) (Control of Transboundary Movement) Regulations, 2002	NEPA Ministry of Local Government and Community Development (National Solid Waste Management Authority) Ministry of Health
12 (1)	Contaminated sites	Identify contaminated sites Establish mechanisms to remediate contaminated sites.	Ministry of Local Government and Community Development (National Solid Waste Management Authority) Office of Disaster Preparedness and Emergency Management Ministry of Health NEPA JBI
16 (1)	Health aspects	Promote awareness on the hazards of mercury exposure. Identify populations at risk and put measures in place to reduce the risk to these groups. Promote safe handling techniques and ensure the use of relevant safety equipment for workers exposed to mercury releases and emissions.	Ministry of Health Ministry of Labour and Social Security Fisheries Division of the Ministry of Industry, Commerce, Agriculture and Fisheries Ministry of Science, Energy and Technology

3.3.3 Institutional Challenges and Priorities

Existing institutional arrangements in Jamaica provide a good basis and opportunities for further enhanced action and support to address the implementation of the Minamata Convention on Mercury, but they need strengthening.

It appears that the institutional challenges to mitigate future mercury pollution revolve around some critical cross-cutting issues, spanning three (3) broad institutional thematic areas, as follows:

- Roles of institutional arrangements for assessing risks for unsound use, management and release of mercury in the environment;
- Coordination, coherence and synergies; and
- Data and knowledge sharing.

In view of the issues involved, the implementation process would involve the need for a sound and proactive communication plan, and a carefully designed governance and accountability action plan. Institutional mechanisms should exist at different levels to mitigate the impact of mercury on the environment, specifically at the legislative and policy levels.

3.3.4 Implementing Arrangements

Jamaica has already established a special purpose vehicle in the form of a National Working Group to allow for inter-sectoral coordination and management of the activities under the MIA project. The Lead Ministry (Ministry of Economic Growth and Job Creation – MEGJC), which is also the Focal Point Ministry for the Minamata Convention, has the responsibility for collaboration and partnership with relevant representatives' organisations comprising national government departments, agencies, and other stakeholder organisations comprising representatives from: academia, private sector organisations, research institutions, manufacturing associations, civil society groups, NGOs, and CBOs to achieve the project development objectives to enable implementation of the Convention.

Partner agencies appointed to the National Working Group, represent the concerns of their membership, with the mandate of addressing issues related to the handling, treatment, use, storage and disposal of mercury, mercury-related products and mercury wastes, as well as, addressing matters pertinent to the implementation of the Convention.

The MEGJC would provide leadership and direction to the working group members through all aspects of the activities to be undertaken. As such, the appointment of representative organisations to the working group would be guided by the level of oversight management that is required for the implementation of the Minamata Convention on Mercury.

By co-opting relevant member organisations on the working group in each country, the Focal Point Ministry receives guidance and technical assistance to further assist it in its work.

It can be concluded from the review of coordination mechanism that reasonably strong institutional arrangements are in place. However, the National Working Group was established under the MIA project and efforts should be made to ensure that the group continues to function post-project to aid in implementation of the Convention. Further collaboration and partnership with a range of other agencies will strengthen the capacity of the main implementing agency. Collaborators should include international and national knowledge centres, as well as, academic and research institutions. The BCRC-Caribbean may also assist in the coordination of regional mechanism in the Caribbean.

Table 30 highlights the representative organisations that should continue as members on the National Working Groups and describes the roles and responsibilities that each is expected to play in coordinating the effective implementation of the various components and sub-components of the Minamata Convention on Mercury.

Table 30: Proposed steering committee representative organizations and associated roles

Proposed Steering Committee Representative Organizations	Summary of Overall Responsibilities and Potential Role under the Minamata Convention on Mercury
Ministry of Economic Growth and Job Creation (Chair)	• Focal point – Coordinate the national implementation of the country's obligations under the Convention; • Develop and review policies, legislation and programmes, as appropriate;
National Environment and Planning Agency (NEPA)	• Environmental Permits and licences; • Control of trans-boundary movements; • Air emission standards; • Regulation of wastewater; • Storage, transport and treatment of hazardous wastes;

Proposed Steering Committee Representative Organizations	Summary of Overall Responsibilities and Potential Role under the Minamata Convention on Mercury
	• Assessing impacts of mercury and other hazardous wastes on the environment (for example, fish kills); • Environmental impact assessments; • Enforcement and monitoring; • Development and implementation of mercury projects, plans and programmes, as appropriate
Jamaica Bauxite Institute	• Oversee the regulation of environmental standards in the bauxite industry; • Conduct regular environmental reviews of bauxite operations to ensure environmentally sound practices
Jamaica Customs Agency	• Monitors imports and prevents illegal imports; • Monitors the storage of items at various warehouses/port facilities; • Performs agency functions on behalf of other government departments and ministries, which are guided by laws which dictate the importation of certain goods
Ministry of Local Government and Community Development (National Solid Wastes Management Authority)	• Regulates and operates disposal of mercury & mercury-related products and other hazardous materials at landfills (for example, thermometers, blood pressure machines, dental amalgams, fluorescent lamps, batteries, cosmetics); • Interim storage of mercury wastes
Office of Disaster Preparedness Emergency and Management (ODPEM)	• Coordinate hazard mitigation, and national responses to major chemical incidents
Ministry of Health	• Regulates environmental health; • Regulates the manufacture, import and export of chemicals; • Administers the Food and Drugs Act and its regulations; • Regulates pesticides and other toxic chemicals; • Responsible for pharmaceuticals for human/veterinary use; • Regulates the import and use of dental amalgam; • Responsible for laboratory chemicals and equipment (including manometers and gauges) in the public sector; and • Provides guidance on procedures to be followed when handling chemicals and other hazardous materials.
Ministry of Labour and Social Security	• Occupational health & safety.
Private Sector Organisation of Jamaica	• Advocacy and special interest.
Ministry of Transport and Mining (Mines and Geology Division)	• Regulates mining and quarrying operations such as; ○ Bauxite mining and processing;

Proposed Steering Committee Representative Organizations	Summary of Overall Responsibilities and Potential Role under the Minamata Convention on Mercury
	○ Metallic minerals extraction, including, gold mining (not currently done but if done in the future); ○ Granting of permits and licences for mining and quarrying, blasting and the export of minerals; ○ Development of guidelines and standards for mining; and Monitors environmental conditions including the health and safety of workers in the extractive industry.
Attorney General's Office	• Formulates the legal and regulatory framework.
Fisheries Division of the Ministry of Industry, Commerce, Agriculture and Fisheries	• Reviews circumstances of fish kill and identification of the causes; • Monitors the Fishing industry
Jamaica Bureau of Standards	• Prepares, promotes and adopts standards related to mercury and mercury-based products; • Promotes standardisation, quality assurance and simplification in industry and commerce.

The MEGJC, in its capacity as the Focal Point, is expected to coordinate the implementation of the Minamata Convention in Jamaica through communications with the relevant agencies and institutions. They are expected to undertake the following:

- Lead a comprehensive consultation process with multiple stakeholder groups to gather input on all components of the Minamata Convention on Mercury, and to solicit the extent of use of mercury nationally, and receive guidance to determine the implications of accession to the Minamata Convention;
- Identify the key performance parameters and synthesise all data into a concise report that leads the project process forward and builds consensus and accountability;
- Regularly consult with the stakeholders and make recommendations regarding the Project parameters as appropriate;

Chapter IV: Identification of Populations at Risk and Gender Dimensions

4.1 Preliminary Review of Potential Populations at Risk and Potential Health Risks

Exposure to elemental mercury and mercury compounds can pose a higher risk to certain populations and targeted groups that are more sensitive to its effects. These groups include:

- Women of childbearing age;
- Pregnant women;
- Foetuses;
- New-borns; and
- Young children (less than 12 years of age).

Pregnant women and women of childbearing age in Jamaica are high risk groups since their exposure to mercury can impact the foetus. The sensitivity of the developing system of foetuses, new-borns and young children can enhance the dangerous impacts of the toxic effects of mercury. Similarly, individuals with preconditions, such as diseases of the liver, kidney, lung and nervous system may be at risk of suffering at this same higher intensity.

Certain groups are exposed to higher levels of mercury, either through a regular diet of fish and aquatic organisms, particularly larger predatory marine animals, occupational or environmental exposure, or through the consistent use of mercury-added products. Article 16 of the Minamata Convention encourages Parties to develop strategies and programmes to identify these sensitive groups and populations at risk to adopt science-based health guidelines and targets to reduce the negative health impacts of mercury exposure, and to increase the capacity of health-care systems to be able to better monitor, prevent and treat affected populations.

4.1.1 Mercury Exposure to Humans through Seafood[16]

Jamaica is a Small Island Developing State (SIDS) with significant populations concentrated along the coast, and fish is a staple food for most of its communities.

[16] Seafood includes marine and freshwater fish and shellfish, as well as marine mammals.

Methylmercury, the organic form of mercury, biomagnifies in aquatic food webs and can therefore affect the population based on consumption.

There are many studies on the impact of methylmercury toxicity to the neurological, cardiovascular, and immune systems within humans. For example, neurological impacts are often measured and become evident through lowered IQ levels (Spadaro and Rabl, 2008) and through various neuropsychological tests (Grandjean et al., 1998). Cardiovascular and immunological impacts are often related to chronic exposure to mercury (Sweet and Zelikoff, 2001; Downer et al., 2017). The relative impacts from methylmercury's toxic effects can vary across human populations as some groups are more sensitive to the impacts of exposure. Methylmercury is known to affect neurological development in children and is also linked to cardiovascular disease in adults (Clarkson et al., 2003; Valera et al., 2011; Grandjean et al., 2012).

Since fish and other seafood are regularly eaten by Jamaicans, vulnerable groups in this country may have a higher risk of exposure to mercury as the mercury bioaccumulates in the aquatic species. Health-based organisations such as the World Health Organisation (WHO), the United States Environmental Protection Agency (U.S. EPA) and the European Commission (EC) have examined fish mercury concentrations to identify the types of fish that are likely to have higher mercury content, and to develop consumption guidelines which indicate the number of seafood meals that could be eaten to stay within the recommended dose.

Table 33 shows guidelines for the safe consumption of seafood containing mercury that were created based on the U.S. EPA reference dose of $1x10^{4}$ mg of Hg/kg of body weight/day, a body weight of 132 pounds (60 kg) for an adult female person, and a fish meal size of about 6 ounces (170 g). These guidelines are for muscle tissues in fish as >95% of Hg is in the methyl form, and therefore this consumption guidance cannot be directly used with the shellfish total mercury data.

For further reference, the WHO and the EC general guidance level for fish mercury concentrations is 0.5 ppm with an "exemption" for larger, predatory fish species of up to 1.0 ppm, which is similar to the U.S. EPA "no consumption" level.

Table 33: US EPA guidance for seafood consumption based on mercury concentrations

Mercury in Seafood (ppm, ww)	Consumption Guidance
≤ 0.05	Unrestricted
0.05 – 0.11	2 meals per week
0.11 – 0.22	1 meal per week
0.22 – 0.95	1 meal per month
> 0.95	No consumption

Some regularly and commercially harvested seafood from Jamaica can be safely consumed either on a daily or weekly basis, as they may have average mercury concentrations under 0.22 ppm, ww. Conch, lobster, tilapia and other small individuals may be among these species. On the other hand, mercury concentrations may be higher in large pelagic, predatory and long-lived species like king mackerel, shark and swordfish. It should be noted, however, that these are not species which are typically eaten in Jamaica. Mean mercury levels in these species may exceed 0.9 ppm, and it is recommended that human consumption be limited to only one meal per month as they are riskier choices. It is recommended that fish and seafood with Hg concentrations over 0.95 ppm, ww should not be consumed regularly.

The Environmental Health Unit of the Ministry of Health capacity was built under the 2017 National QSPTF Project to undertake mercury analyses in several media, including fish. The Laboratory completed mercury analyses of fish under the Project in 2017. At present, the Ministry of Health is considering the regular monitoring of local fish to assess mercury levels.

The monitoring of mercury in fish and seafood in Jamaica will inform advisories on healthy dietary practices throughout the country.

4.1.2 Occupational and Environmental Exposure to Mercury

Populations involved in professions that expose them to elemental mercury or mercury compounds are at a higher risk due to the increased frequency of exposure. The potential risks to the relevant occupations in Jamaica are described below in Table 34.

Table 34: Occupational exposure to mercury in Jamaica

Occupation	Cause of Potential Mercury Exposure
Dental professionals including dental assistants	Preparation, use and disposal of dental amalgam fillings Use and handling of mercury-containing medical devices
Medical professionals	Use and handling of mercury-containing medical equipment such as thermometers, sphygmomanometers and other manometers and gauges Clean-up of damaged or broken equipment
Waste collectors, medical waste incinerator workers and landfill workers	Handling of end-of-life mercury-containing products from households and hospitals, including fluorescent light bulbs, batteries, cosmetics, and electrical switches and relays Handling of mercury containing wastes from industries such as bauxite residues, and flue ash from cement and lime aggregate production Incineration of mercury-containing products
Environmental/enforcement officers	Identification, monitoring and evaluation of potentially contaminated sites and mercury-containing products
Firemen and first responders to chemical accidents	Clean-up of mercury-containing chemicals and products
Laboratory workers	Use and clean-up of mercury-containing chemicals
Other industrial workers	Inhalation of mercury-contaminated particles from cement and lime aggregate production sites, bauxite mining facilities, oil refineries, waste incineration facilities, etc.

People living in areas that are more susceptible to environmental contamination by mercury are also more likely to be affected by mercury exposure. These higher risk areas are typically around hot spots and point sources of uncontrolled mercury releases such as landfills and other waste disposal sites, bauxite mining sites, the cement production facility, wastewater treatment plants, and other industrial facilities that release mercury and mercury compounds into the environment. Point sources of mercury releases should implement controls to reduce emissions to the environment and decrease the risk to nearby residents.

4.2 Assessment of Potential Gender Dimensions Related to the Management of Mercury

The Basel, Stockholm and Rotterdam Conventions have highlighted the importance of ensuring gender mainstreaming in countries to implement these Conventions as well as the Minamata Convention on Mercury. The United Nations Economic and Social Council (UN ECOSCO) has defined 'gender mainstreaming' as "a strategy for making women's, as well as men's concerns and experiences an integral dimension of the design, implementation, monitoring and evaluation of the policies and programmes in all political, economic and societal spheres so that women and men benefit equally and inequality is not perpetuated" (UNDP, 2007).

Gender mainstreaming is also a critical component for countries to achieve gender equality; that is, a society where "the interests, needs and priorities of both women and men are taken into consideration" and where "the diversity of different groups of women and men" are recognised. Gender equality is listed as one of the United Nations Sustainable Development Goals.

Mercury exposure to men and women vary due to differences in the frequency of contact through gender-determined occupational and household roles, and cultural practices. The health impacts resulting from exposure also varies between men and women as a result of physical differences that make women more sensitive to the effects of the toxic compound. It is therefore important to consider the differing roles of gender with regards to the exposure and management of mercury, and to ensure that gender considerations are effectively mainstreamed into any future mercury management plans.

An extensive survey and assessment of gender issues related to mercury exposure in Jamaica is not yet defined. However, a descriptive summary was developed to broadly apply across the country's populations relating to general exposure and gender risks within various sectors where mercury contamination is likely to occur. Exposure to mercury in Jamaica is expected to occur through fish consumption, household use and disposal of mercury-added products (MAPs), occupational exposure to mercury and its compounds, and the use of skin-lightening creams containing mercury. It was noted that while mercury exposure from fish consumption and domestic use of MAPs may not vary

significantly between sexes, the health risk is likely greater in pregnant women and women of childbearing age.

Identifying these trends are useful when considering training, education, and awareness-raising strategies regarding mercury exposure. These trends allow for the development of more gender-sensitive communication strategies that can target the sexes differently to achieve maximum benefit in Jamaica.

Although there is no national policy which specifically addresses gender, there is a National Policy for Gender Equality which speaks to, *inter alia*, gender equality as a key component in addressing unequal arrangements and long systemic discrimination in the Jamaican society

4.2.1 Occupational Exposure

According to data from the Statistical Institute of Jamaica, in 2014, female participation in the Jamaican labour force was below male participation in all age groups. Table 35 collated by the UN Women: Caribbean (2017) shows the differences in labour participation rates. Further, in 2015, female unemployment was 7.8% higher than corresponding values for the male population.

Table 35: Jamaica's 2014 labour force participation rates by gender

Age Group	Male Participation	Female Participation
20 – 24	70.9%	55.5%
25 – 34	89.9%	77.9%
35 – 44	93.4%	78.6%
45 – 54	91%	76%
55 – 64	80%	57.5%

While it is evident that a greater portion of men are employed in Jamaica, gender differentiation among workers in various occupational roles still needs to be taken into consideration since certain jobs that may expose workers to higher levels of mercury, may be more oriented towards women and vice versa. Table 34 shows the Jamaican occupations that potentially expose workers to mercury.

Data compiled by the Statistical Institute of Jamaica in January 2014, using occupational information gathered through the 2011 census, was used to estimate the percentage of the labour force employed in relevant sectors (Figure 22).

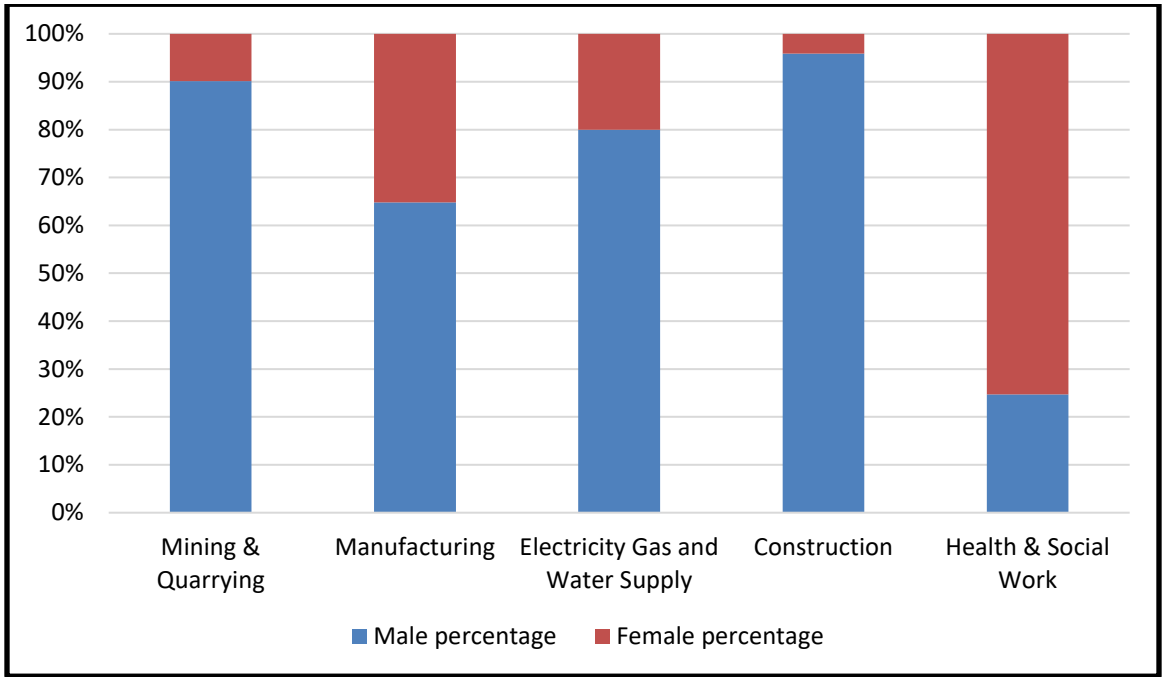

Figure 22: Distribution of sectors potentially exposing workers to mercury in 2014 by gender (Data Source: The Statistical Institute of Jamaica, 2014)

Male-dominated occupations in Jamaica include those in the mining and quarrying, manufacturing, electricity, gas and water supply and construction sectors. Contrastingly, the data showed that approximately 75% of the health sector is made up of women. As such, it is expected that mercury exposure from the bauxite industry, cement and lime aggregate production industries, oil refineries and wastewater treatment facilities predominantly affect men; while contact with mercury in the health sector primarily impacts women. These assumptions do not take into consideration the proportion of workers in each sector that do not come into direct contact with mercury and its compounds.

Healthcare workers include dentists, doctors, nurses, technical assistants, facility maintenance staff, administrative staff and other medical staff who may or may not come into contact with mercury and its compounds. Nurses are most likely to use mercury-added medical devices and clean-up broken mercury-added products. A

negative perception of male nurses in Jamaica continues along with low recruitment rates of male nurses, so it is expected that a greater percentage of nurses are female (UNDP Jamaica, 2016). Further, according to an interview with Dr Sanneta Myrie, a medical doctor in Jamaica and gender equality advocate, women outnumbered men in the field of medicine by a ratio of 4:1 (Jamaica Observer, 2016). Of 188 dental professionals listed as members on the Jamaica Dental Association Website, 88 were female and the rest were male (based on assumptions of gender by name). It was noted, however, that the technical assistants and other supporting staff at dental practices were more likely to be female. As such, it can be assumed that more females are affected by mercury exposure in Jamaica's healthcare field.

In Jamaica, waste collectors and workers at waste incineration and landfill facilities are estimated to be primarily male. Similarly, firemen and first responder occupations are also expected to be held by men. A brief survey of the websites of several environmental organisations such as the Jamaica Environment Trust, the Environmental Foundation of Jamaica, and NEPA showed that the gender distributions among key enforcement officers and environmental workers were relatively equal. A primary gender involved in laboratory work was also not determined.

Based on the preliminary information gathered, it seems that there is a tendency for men to have a greater risk to occupational mercury exposure except for individuals within the health sector. However, a further, more in-depth study of the gender ratios for these professions would be required to accurately confirm and quantify patterns of exposure and at-risk populations, according to gender and occupation type.

4.2.2 Mercury in Cosmetics

The use of skin-lightening cosmetics has been noted in Jamaica. In 2004, approximately 10-15 percent of patients seen by dermatologists, practiced skin bleaching (Andrew, 2004). While both men and women have been found to use skin-lightening products in Jamaica, research has shown that the practice is more predominant among women who believe that lighter skin would equate to more culturally determined advantages such as increased pay in the workforce, marriage, and social acceptance (Charles, 2003; Djanie, 2009; Hunter, 2011; cited by Edmond, 2014).

It is believed that this stigma has been perpetuated by the cultural aftermath of colonialism (Lewis et al., 2011).

Mercury has been found to be present in skin-lightening products used in Jamaica, though the risk of exposure using these products is still being determined. The precise rate of dermal absorption of inorganic mercury is influenced by many factors which have made it difficult to assess (WHO, 2014). However, some research has shown that the use of skin-lightening creams by women with children have led to greater risks of mercury transfer to their children. Copan, et al (2015) detailed a case in which a 20-month old child was diagnosed with mercury poisoning which was attributed to the use of a skin-lightening cream found to contain 38,000 ppm Hg by the child's mother.

Chapter V: Awareness/Understanding of Workers and the Public; and Existing Training and Education Opportunities of Target Groups and Professionals

The level of awareness on the risks of mercury among identified stakeholders and target populations in Jamaica can vary based on the information provided. Measures should be put in place to educate these groups on the hazards of mercury exposure and the possible actions to mitigate the risks. Article 18 in the Minamata Convention on Mercury states that:

1. Each Party shall, within its capabilities, promote and facilitate:
    a) Provision to the public of available information on:
        i. The health and environmental effects of mercury and mercury compounds;
        ii. Alternatives to mercury and mercury compounds;
        iii. The topics identified in paragraph 1 of Article 17;
        iv. The results of its research, development and monitoring activities under Article 19; and
        v. Activities to meet its obligations under this Convention;
    b) Education, training and public awareness related to the effects of exposure to mercury and mercury compounds on human health and the environment in collaboration with relevant intergovernmental and non-governmental organisations and vulnerable populations, as appropriate.
2. Each Party shall use existing mechanisms or consider the development of mechanisms, such as pollutant release and transfer registers where applicable, for the collection and dissemination of information on estimates of its annual quantities of mercury and mercury compounds that are emitted, released or disposed of through human activities.

Residents near mercury point-sources, such as industries that burn coal or co-incinerate waste and facilities that handle waste disposal and incineration, should be informed of

the added risk of mercury exposure. These targeted groups should be directed on proper safety measures to reduce risks. Similarly, workers at these facilities can be educated on the proper use of personal protective equipment to reduce exposure and measures to reduce the release of mercury to the environment.

It is recommended that medical and environmental professionals in Jamaica be trained in assessing and monitoring mercury-related issues to better identify the extent of the effects of exposure to communities. This information would also serve to further expound on preventative measures and appropriate treatment options for affected populations. Collaborating with the World Health Organisation (WHO) may aid the Government of Jamaica in these efforts.

Mercury-added products add risk of mercury exposure to the population on a whole. Awareness of alternatives to mercury-added products sold in Jamaica can be raised to encourage a safer consumer choice for the citizens. Citizens should be encouraged to support initiatives that would lead to the complete phase-out of mercury-added products. National action to raise public awareness of mercury hazards should be undertaken in parallel with encouragement for public involvement in reducing environmental and health impacts of mercury contamination. Avenues to facilitate public responsibility should be put in place, such as access to collection, recycling and disposal systems, and incentives for using mercury-free alternatives. Guidelines for separation of contaminated wastes should be created and enforced by municipalities and private waste collectors.

The mercury content in specific brands of skin-lightening creams, soaps, batteries and other potentially mercury-containing goods needs to be identified through testing or from existing inventories. Lists of these items should be compiled and distributed to consumers to raise awareness of the sources and risks of mercury exposure, and proper methods to safely store, handle, transport and dispose of mercury wastes. In 2018 stakeholder discussions, the University of the West Indies (UWI) indicated that a project was being conducted, with support from the Washington DC-based Pan American Health Organization (PAHO), under which further research on mercury in

skin-bleaching products used in Jamaica was being done. It is anticipated that once the research is published, a public health advisory will be provided (Folkes, 2018).

Under the MIA project, a national video and infographics have been developed to highlight the issues posed by mercury in Jamaica and the wider Caribbean.

It is also important to inform the public of available, cost-effective mercury-free and mercury-reduced alternatives that could replace the harmful products being used. The department that oversees consumer affairs within the relevant ministry that regulates trading and industry activities would be responsible for disseminating this information.

Chapter VI: Implementation Plan & Priorities for Action

Article 20 of the Text of the Minamata Convention on Mercury states that, “each Party may, following an initial assessment, develop and execute an implementation plan, taking into account its domestic circumstances, for meeting the obligations under this Convention.”

The development of an implementation plan is the responsibility of the Government and is optional. The following highlights some of the practical considerations in relation to the relevant Minamata Convention obligations that may be taken should the Government of Jamaica choose to develop an implementation plan.

6.1 Recommendations for Management of Mercury-Added Products (whole life cycle)

The manufacture and use of mercury in products and in mercury-containing processes or devices (mercury-added products) needs to be addressed to ensure that the Government of Jamaica follows the obligations of the Minamata Convention as set out in Article 4.

Annex A, Part I of the Minamata Convention lists the products that a Party is required to not allow the manufacture, import and export by 2020, except where an exclusion is specified in Annex A or the Party has a registered exemption pursuant to Article 6. It also lists the mercury-containing products not regulated by the Convention, and those that are exempt from the 2020 phase-out.

The obligations for the disposal of such mercury-added products are also outlined in Article 11. While some of the mercury in these products can be collected and recycled, Jamaica faces issues which reduce the feasibility of such measures. These issues include a lack of enforced requirements for manufacturers to list all the components of their products, which leaves users and disposers unaware of the need for special disposal, inefficient collection and disposal systems, a lack of access to storage and

recycling facilities, and little public awareness on the hazards of mercury-added products and their proper disposal.

In Jamaica, mercury-based pesticides are prohibited under the Pesticides Act, 1987. However, there will be need for additional measures to address the other mercury-added products listed under Annex A, Part I. Specific recommendations for managing the manufacture, import and export of these products under legislation and regulatory framework were detailed in Chapter III of this report. Other recommendations for the phase out of mercury-added products in Jamaica are listed in Table 34 as detailed by Lennett and Gutierrez (2016).

Table 34: Recommended action for phasing out MAPs (adapted from Lennett and Gutierrez, 2016)

MAP	Recommended Action for Phase-Out
Switches and Relays	● Promote the use of Hg-free alternatives which are already widespread on the market. For example, electronic mercury-free alternatives are proven effective and widely available and many manufacturers now produce mercury-free switches and relays because of restrictions in the EU's RoHS Directive. Mercury-free alternatives include hybrid tilt switches and electronic thermostats[1] ● Take measures to prevent use as components in larger products like pumps, appliances, ovens and circuit boards ● Ensure that allowable high accuracy capacitance and loss measurement bridges and high frequency radio frequency switches and relays in monitoring and control instruments maintain a maximum mercury content of 20 mg per bridge, switch, or relay ● Set up waste electrical and electronic equipment (WEEE) dismantling plants to remove switches and relays from non-hazardous waste streams
Batteries	● Promote the use of Hg-free alternatives, such as cylinder (alkaline rechargeable) batteries which are already common on the market[1] ● Prevent the import and use of mercury-containing batteries in devices used for medical, industrial or military applications and electronics ● Ensure that allowable mercury-containing button zinc silver oxide and button zinc air batteries used maintain acceptable limit of <2% Hg content. This limit is typically in accordance with the batteries on the global market currently. ● Put measures in place, e.g. WEEE dismantling plants, to remove batteries from non-hazardous waste streams
Lighting Devices (CFLs, LFLs, HPMV, CCFLs, EEFLs)[2]	● Promote the use of LEDs and other Hg-free lamp alternatives for general purpose lighting and LCD backlighting.[1] (The amount of Hg needed per lamp has decreased over the years due to technology/production improvements, including better dosing; therefore, meeting this requirement globally is becoming easier. The People's Republic of China which manufactures many of these products for worldwide export is Party to the Minamata Convention and have implemented plans to meet the obligations for manufacture in accordance with the Convention's obligations [Kamande, 2017]) ● Set and enforce low maximum mercury content limits for lamps imported and used ● Restrict the use of HPMV and enforce the use of available alternatives ● Purchase bulb-eaters to facilitate recycling or environmentally sound disposal of end-of-life fluorescent tubes

MAP	Recommended Action for Phase-Out
	• Set up WEEE dismantling facilities to separate CCFLs and EEFLs from non-hazardous waste streams
Non-Electronic Measuring Devices (Barometers, Hygrometers, Sphygmomanometers, Thermometers etc.)	• Promote the use of cost-effective Hg-free alternatives. Digital and aneroid Hg-free alternatives to these products are already popular on the global market. Guidance documents on phasing out these products have been developed by the World Health Organisation and Health Care Without Harm who began a global campaign to shift the production of mercury-added medical devices to Hg-free alternatives by 2017[1] • Enforce on-site separation of these devices from non-hazardous waste streams and waste incineration streams
Cosmetics (Skin-Lightening Products)	• Establish measures to regulate the import and local manufacture of skin-lightening products[3] • Compile a local inventory of mercury-containing cosmetics to better inform governments and public[3] • Develop and enforce proper labelling standards • Promote the use of cost-effective Hg-free alternatives • Ban the manufacture, import and export of mercury-added cosmetics • Conduct public awareness campaigns
Dental Amalgam	• Encourage the use of cost-effective and clinically effective mercury-free dental restoration options to phase-out the use of Hg-added dental amalgam • Provide training and education opportunities for professional dentists and students in dental school on mercury-free dental restoration options and best practices[4] to prevent release of mercury into the environment

1 Some of the recognised existing guidance documents are available at the following links (Kamande, 2017):

- *Report on the major mercury-containing products and processes, their substitutes and experience in switching to mercury-free products and processes, UN Environment OEWG2: http://www.mercuryconvention.org/Portals/11/documents/meetings/oewg2/English/2_7.pdf*
- *Mercury-added Product Fact Sheets, Northeast Waste Management Officials Association: http://www.newmoa.org/prevention/mercury/imerc/FactSheets/*

- *Developing National Strategies to Phase Mercury Out of Thermometers and Sphygmomanometers Including in the Context of the Minamata Convention on Mercury, WHO: http://www.who.int/ipcs/assessment/public_health/WHOGuidanceReportonMercury2015.pdf*

2 Compact fluorescent lamps (CFLs), linear fluorescent lamps (LFLs) and high-pressure mercury vapour lamps (HPMV) are used for general lighting purposes; Mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) are used in electronic displays.

3 Skin-lightening products are one of the most unregulated MAP sectors in the Caribbean. Due to the rising popularity of skin bleaching within communities and the prevalence of informal local and international manufacturers and retailers, it is critical that countries put measures in place to identify and restrict products on the market that contain mercury. As many of these products tend to be mis-labelled/ improperly labelled, the mercury concentration in such products can only be accurately determined through laboratory analysis and research. Projects are currently being conducted globally by organisations under the Global Mercury Partnership to assess mercury concentrations in popular skin-lightening creams and make the results publicly available. Locally, research is being conducted by the University of the West Indies with funding from PAHO to analyse mercury concentration in skin-lightening creams and conduct public awareness campaigns based on the results.

4 To prevent the release of mercury into water supplies during the removal of existing mercury-containing dental amalgams, dentists should be strongly encouraged to purchase brands of dental chairs that are fitted with amalgam separators which trap excess amalgam. Amalgam captured by the filters should be captured during periodic cleaning efforts, and the mercury-containing waste should be transported to a facility for recycling. Temporarily stored dental amalgam should utilise the underwater storage method outlined on page 13 of the UNDP/GEF Global Healthcare Waste Project: "Guidance on the clean-up, temporary or intermediate storage, and transport of mercury waste from healthcare facilities" document (Emmanuel, 2010). This has been noted as being done in some public health facilities in Jamaica.

Other recommendations to promote the phase-out of mercury-added products include the following:

Import Regulations

Under Article 4 of the Minamata Convention, Parties will not be permitted to manufacture, import or export certain mercury-added products after the year 2020. To facilitate this transformation, the Government of Jamaica should strengthen the standards with regards to MAPs by beginning to phase-out these products, setting and enforcing maximum allowable mercury content for products that have no available mercury-free alternatives, and ensuring transparent product labelling and training of customs officers to inspect and regulate the import of these products.

The responsible entities in Jamaica for the inspection and approval of goods that may contain mercury are the Bureau of Standards Jamaica (BSJ), under the Ministry of Industry, Commerce, Agriculture & Fisheries and the Standards and Regulation Division under the Ministry of Health as well as the JCA, under the Ministry of Finance and the Public Service.

Product Labelling

Manufacturers of certain goods are not required by law to list all the components of their products. As such, numerous imported and local brands of items, including skin-lightening creams, cosmetics and electronics are not properly labelled to reflect mercury as an ingredient, do not disclose the toxic properties of the compound, and do not inform users of proper end-of-life management. Since consumers and disposers are unaware of the hazardous nature of these products, they are ignorant of the risks associated with handling them, and proper separation and environmentally sound disposal do not take place.

Developing and enacting legislation that enforces transparent labelling of products by their producers are, therefore, critical steps to aid in the proper collection and disposal of such goods, and to raise public awareness that would lead to the subsequent phase-out of manufactured and imported mercury-added products. Figure 23 is an example of a label that discloses the presence of mercury in fluorescent bulbs and directs users to further information on clean-up procedures and safe disposal.

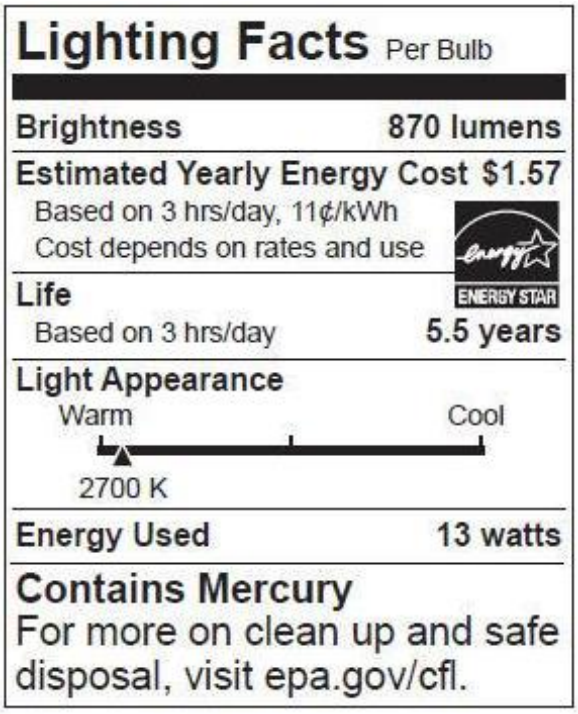

Figure 23: Sample of label for bulbs containing mercury (Source: US EPA, date unknown)

Inspection and Testing

Critical MDAs such as the Ministry of Health- the Department of Government Chemist, NEPA, JCA, JBI and BSJ, will need to acquire equipment for the inspection and testing of MAPs entering the country as well as being used by the citizenry. These MDAs, which oversee the inspection and approval of imported and locally manufactured goods, may consider purchasing a Direct Mercury Analyzer (DMA) to test potentially mercury-containing products that are available, or will be made available, to the public. The Milestone DMA-80 is an example of equipment that could be used to test up to 40 liquid or solid samples at a time (Figure 24). Samples do not need to be prepared with additional chemicals as with older mercury analysers, and mercury concentrations between 0.01-300 ppm can be detected in as little as 120 seconds (Milestone, 2013). The cost of this equipment ranges from 20,000€ to 38,000€ based on the application and configuration required to achieve the aims of the establishment.

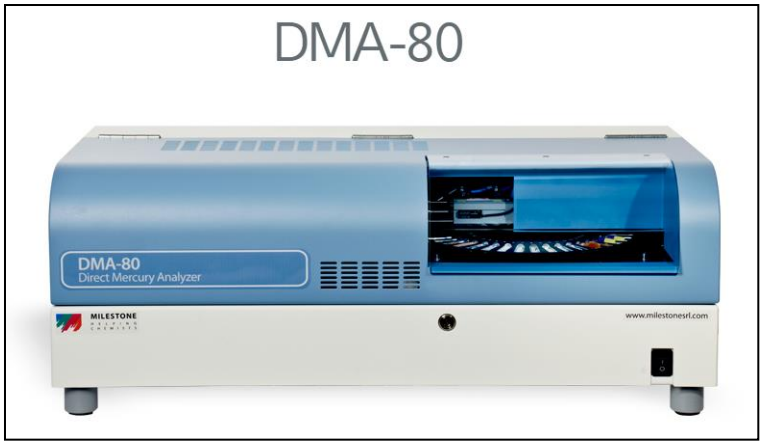

Figure 24: Milestone DMA-80 Direct Mercury Analyzer
(Source: Milestone, 2013)

Identified mercury-containing products should be placed on a restricted list, and Customs workers should be trained to recognise them to aid in preventing them from entering the country. Furthermore, Customs Officers should be trained and equipped with a portable mercury analyser, such as the Lumex RA-915M Mercury Analyzer, which would enable them to identify unlisted mercury-added items being collected at the ports, and more importantly, incoming MAPs that are not clearly labelled to show that they contain mercury (Figure 25). The RA-915M can detect mercury in air samples with concentrations as low as 0.5 ng/m^3 or 0.0005 ppm and will give a real-time rapid analysis of mercury contained in complex objects (Lumex Instruments, 2017). The sensitivity of the RA-915M will aid in the identification of smaller, unidentified mercury-containing components, such as batteries and switches in electronic equipment. The Lumex RA-915M Mercury Analyzer costs approximately US $30,000.



Figure 25: Lumex RA-915M Portable Mercury Analyzer
(Source: Lumex Instruments, 2017)

Extended Producer Responsibility

Measures can be put in place to transfer the responsibility of the end-of-life management of mercury-added products from municipalities to producers and retailers through take-back collection programmes and extended producer responsibility (EPR). With established take-back programmes, consumers would be able to return mercury-containing wastes to the producers and retailers that sold them the items. These producers and retailers must then ensure the environmentally sound interim storage, transportation and disposal of the collected wastes. The Government should encourage participation by relevant stakeholders and provide legislation that directs the responsibilities of the involved parties and the methods that would be used for monitoring and enforcement of the programme requirements. The development of take-back regulations is currently being done by the NSWMA for the environmentally sound management of e-waste and could be expanded to include provisions for all mercury-added products.

6.2 Recommendations for Management of Mercury Emissions and Releases

Under Article 8 of the Minamata Convention, measures should be undertaken to control and reduce emissions of mercury and mercury compounds (total mercury) to the atmosphere from point sources within the source categories listed in Annex D. In Annex D, the relevant point sources in Jamaica refer to:

- Waste incineration facilities (not assessed under the MIA project); and
- Cement clinker production facilities

Under Article 9 of the Minamata Convention, Parties shall take measures to control releases to water and land from major point sources and may prepare a national plan to assist in the monitoring of the effectiveness of implementation. Based on the mercury inventory conducted, mercury released due to alumina production from bauxite was the most significant source.

Under these Articles, Parties must:

- Implement either one or more of the following measures to “control” releases:
    - Develop mercury release limit values;
    - Use Best Available Techniques (BAT) / Best Environmental Practices (BEP);
    - Implement a multi-pollutant control strategy; and/or
    - Develop alternative measures to reduce releases.

Parties are also encouraged to regularly update their inventories of mercury emissions and releases.

In Chapter III of this report, it was noted that Articles 8 and 9 are covered under the NRCA Air Quality Regulations and NRCA Wastewater and Sewage Regulations respectively. Legislative recommendations to enhance the effectiveness of the Convention’s obligations are also covered in Chapter III. Further recommendations that may be considered for point sources of mercury emissions and releases are detailed below:

Alumina Production from Bauxite

It has been noted in Chapter II that measures are already in place in bauxite mining and alumina refining companies to collect mercury wastes for secure interim storage and to reduce releases to general waste through processes. Further assessments into the procedures practiced by each of the companies will allow for a more accurate inventory of mercury releases to be determined.

The bauxite mining and alumina processing industry in Jamaica should continue to ensure that legislation regarding the releases of hazardous chemicals into the environment are being complied with consistent monitoring of work practices and ambient conditions in the areas. These measures may include fugitive emission control plans, reducing the mercury content in gaseous emissions from stacks at alumina plants, and utilizing more environmentally sound methods for the collection, treatment

and disposal of wastes[17] generated from mining operations and waste effluents generated from processing facilities. Additionally, the continuous monitoring of the mercury concentrations in air, soil and water in the areas adjacent to mining and processing operations is advised.

Carlson, et. al (2011) lists several mercury controls that could be implemented (if not already) in the alumina industry to reduce mercury content in emissions and effluents. These include:

- While transporting ore, material should be properly covered to prevent the release of potentially contaminated particles to the environment.
- Air pollution abatement systems should be added to stacks to prevent release of gaseous mercury into the surroundings.
- Mercury wastes from the bauxite industry that are collected and stored in containers should be handled following the guidelines outlined by the Basel Convention and as stated in the national regulatory framework.

Regular monitoring and enforcement of the procedures will ensure optimal efficiency in mercury management in the bauxite mining and alumina processing sector.

Cement and Lime Aggregate Production

In Jamaica, based on 2016 data, coal or a coal blend was used as the main fuel source for cement production along with co-incineration of waste. Using co-incineration of waste as a fuel source, releases approximately 0.4 grams more mercury per tonne of cement produced (UN Environment, 2017a). Therefore, with further consideration of using co-incineration of wastes as a fuel source by companies, more efficient emission-control measures should be considered and implemented.

Simple particle fabric filters (FF) which reduce the output of mercury to air by up to 25% (UN Environment, 2017a) are used in Jamaica with no filter dust recycling. It is critical

[17] The management of mercury waste from the bauxite industry are governed locally by the Natural Resources Conservation (Permits and Licenses) (Amendment) Regulations 2015, and in the event, there is to be export, by the Natural Resource (Hazardous Waste) (Control of Transboundary Movement) Regulations, 2002

that industries assess the range of operating conditions in their kilns to identify more cost-effective and efficient end-of-pipe mercury pollution control technologies that could be applied to facilities to eliminate the mercury vapour output during the pyro-processing phase of cement and lime aggregate production. BAT and BEP should be used to ensure maximum control and reduction of emissions. Implementing these controls would generate more mercury contaminated wastes, and environmentally sound management techniques should be put in place to ensure the proper treatment and disposal of the increased volumes to this waste stream.

The cement production industry in Jamaica has put in place some measures to contain dust particles and prevent them from becoming airborne, to effectively clean up and recycle spilled material, and to recover, treat and reuse wastewater. The efficiencies of these procedures should be determined through continuous monitoring and evaluation.

Cemeteries and Crematoria

Although it is difficult to remediate existing cemeteries of their potential mercury contamination, there are procedures to consider for the future reduction of mercury releases in cemetery and cremation practices.

It is recommended that future cemetery site developments should be considered with respect to environmentally-sensitive areas. Cemeteries should not be located near waterbodies, vulnerable ecosystems and floodplains. It is also necessary to consider the future placement of crematories as they should not be in areas that are downwind of densely populated or vulnerable areas.

For crematoria, emission stacks should be monitored for mercury emissions and the funeral homes may consider the introduction of modern mercury filtration systems, carbon injection methods, scrubbers or dust filters into their crematoria chambers. This, however, is an expense that may not be feasible. Cultural, social, structural, financial and heritage boundaries of individual funeral homes are to be considered when recommending changes to determine feasibility.

With the use of water monitoring equipment in boreholes in the vicinity of the cemetery tied with the respective cemetery practices, the extent of the mercury contamination can

be tested and monitored regularly to determine if mercury contamination is an issue (Jonker and Oliver, 2012).

In Jamaica, the construction and operation of cemeteries and crematoria are governed by the Natural Resources Conservation (Permits and Licences) (Amendment) Regulations, 2015.

6.3 Recommendations for Management of Mercury Wastes

Under Article 10 of the Minamata Convention, measures for the environmentally sound interim storage of mercury other than waste mercury are outlined. In Jamaica, mercury other than waste mercury may be produced due to processes involved in the bauxite industry, though it is not anticipated that this Article will be relevant due to the anticipated small quantities of mercury being collected from this process.

However, under Article 11 of the Minamata Convention, measures should be taken to ensure the environmentally sound management of wastes that are:

a) Consisting of mercury or mercury compounds;

b) Containing mercury or mercury compounds; or

c) Contaminated with mercury or mercury compounds.

The results of the MIA project in Jamaica gave an indicator of the anticipated volumes of mercury and mercury-added products that would need to be stored and eventually disposed. However, the amount of mercury waste in the inventory showed that it would not prove economically viable to create mercury-specific interim storage facilities in Jamaica. An integrated waste management approach, where mercury would be stored with other hazardous waste chemicals, is suggested as a more feasible option. Suggestions for management of mercury wastes are detailed below.

Stabilisation, Solidification and Interim Storage of Mercury Wastes

It is important to create guidelines that ensure that the compatibility of these waste chemicals is considered first and that radioactive, infectious, or explosive wastes are excluded. Further detailed guidelines for construction, placement and important

inclusions for interim storage sites for mercury can be found in the Draft Interim Storage Guidelines outlined at the first Conference of the Parties to the Minamata Convention (UN Environment, 2017b) and the UN Environment 'Practical Sourcebook of Mercury Storage and Disposal' (2013). Guidelines under the NRCA Permits and Licences Regulations would also need to be considered.

Collection methods and transportation procedures are crucial in the success of an environmentally sound hazardous waste storage facility. Jamaica's government may dedicate collection centres throughout the nation with easy access to the public or organise mail-in or pick-up services. Vehicles transporting mercury waste need to adhere to specific requirements, such as creating routing plans to ensure the shortest and fastest routes are used, ensuring the presence of a bulkhead between the driver and the vehicle body, and confirming appropriate safety and emergency equipment are on board. It is essential for mercury waste to be packaged in compatible and sealed containers and not stacked more than 1.5 meters high (Emmanuel, 2010).

Another recommendation for developing a comprehensive mercury management plan in Jamaica is to design and implement a fixed storage, pre-treatment and stabilisation/solidification facility for mercury waste before sending it off to a recycling facility or a specially engineered landfill (SEL). The requirements for this proposed facility will be the same as was recommended for the interim storage facility. However, the site will also include the implementation of measures for the environmentally sound separation of contaminated and non-contaminated materials to reduce the volumes of waste exported for mercury recovery, and the stabilisation of mercury-containing wastes for disposal. As with the interim storage facility, it is recommended that this facility should also be capable of storing and treating other hazardous chemicals for safe disposal.

Mercury-contaminated wastes being disposed in SELs should be minimised and subsequently eliminated. The fixed storage, pre-treatment and stabilisation facility will achieve this by implementing processes, such as chemical oxidation and precipitation, which solidify mercury dissolved in liquid wastes, such as waste sludge from industries, thus facilitating separation and recovery. The facility should also be equipped with

chemicals needed to successfully execute stabilisation and solidification procedures on mercury-contaminated cosmetics, dental amalgam, sewage sludge, residues and other wastes that cannot be recovered or recycled.

Hydramag, an industrial stabilising agent based on magnesium oxide, was shown to significantly decrease the volumes of leachable mercury from mercury-contaminated soil in Mongolia (Figure 26). The results of this study showed that using stabilisation methods to treat similar wastes before disposal in specially engineered landfills can greatly reduce the leaching potential of mercury and prevent pollution of surface water and groundwater (UNIDO, 2017). Treated material should be temporarily stored until a SEL is established or transported to an international disposal site in accordance with Basel Convention requirements.

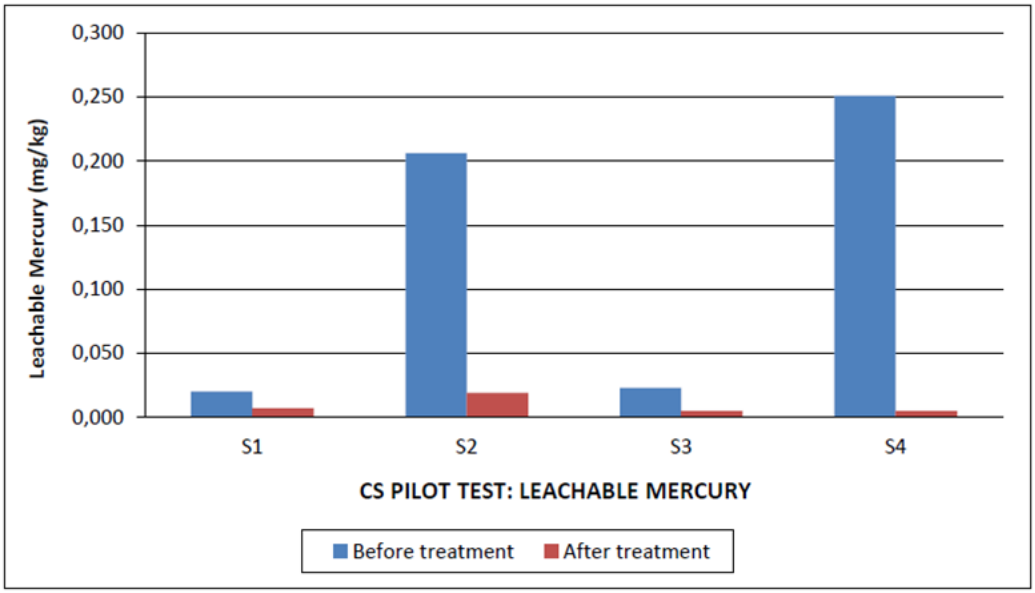

Figure 26: Mongolia chemical stabilisation pilot test on mercury-contaminated soils (Source: UNIDO, 2017)

Additionally, facility operations should include dismantling of waste electrical and electronic equipment (WEEE) into mercury-containing components, such as switches and relays, batteries, CCFLs and EEFLs, and non-hazardous recyclable components. Section 7.3 of the Basel Convention Partnership for Action on Computing Equipment Guideline on environmentally sound material recovery and recycling of end-of-life

computing equipment has information that could be used to determine the best methods for engaging in e-waste dismantling activities.

To facilitate the safe recycling or disposal of fluorescent tubes (CFLs and LFLs), a bulb recycler system or a bulb crusher should be purchased. The purchased equipment should be able to handle various sizes and shapes of fluorescent bulbs and should utilise vapour filters to minimise dust and mercury vapour emissions. A bulb recycler system would separate mercury-bearing phosphor powder from the other components of fluorescent bulbs (glass and aluminium/plastic) and clean the separated materials which can then be recycled or disposed. CMA Ecocycle in Australia is an example of a facility that successfully manages this approach (CMA Ecocycle, 2015).

A drum-top bulb-crusher or other bulb-crusher mechanically crushes the fluorescent tubes and collects the waste-material in an airtight drum. The bulb crusher does not separate the glass, end caps or mercury-bearing phosphor powder, and all collected material, including used filters, will have to be sent to another facility for separation and recycling, or encapsulated in a mercury-immobilising material before being disposed of in a managed engineered landfill. Crushing the bulbs before shipping for treatment or disposal reduces the volumes needed to be transported, and therefore reduces the associated costs. The Dextrite bulb crusher shown below (Figure 27) costs approximately USD 15,000, inclusive of transportation costs.

The Basel Convention ‘Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with mercury or mercury compounds’ is a useful resource for environmentally sound handling (F1), separation (F2), collection (F3), packaging and labelling (F4), transportation (F5), storage (F6) and disposal (G) of mercury contaminated wastes. The listed measures should be followed when constructing and operating the recommended facility.

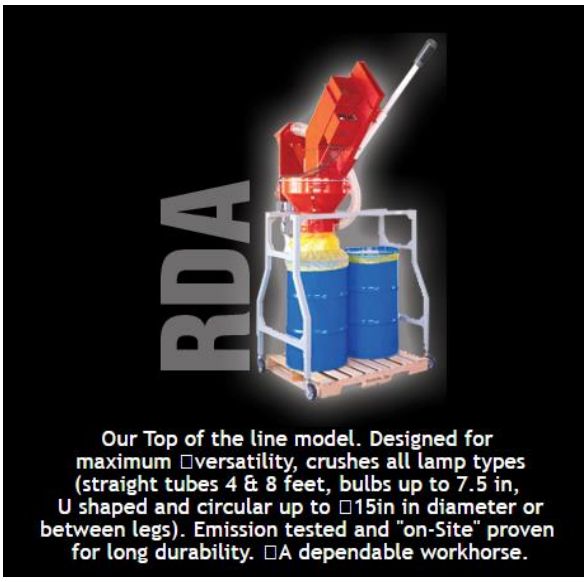

Figure 27: Features of the Dextrite bulb crusher (Source: Dextrite, 2017)

All processes should be conducted under reduced pressure to prevent leakage of mercury vapour. Additionally, exhausted air should be directed through a series of particulate filters and a carbon bed to prevent mercury release into the environment. Workers need to receive thorough training on the appropriate and environmentally sound measures of handling purchased equipment and contaminated materials, as well as measures to ensure occupational safety and health. They should also have access to appropriate personal protective equipment (PPE) which they should always wear. There needs to be consistent ambient testing done at the site to ensure that emissions are contained and that the concentration of mercury is within the allowable limits.

Waste Disposal

Proper waste management methods are essential for the protection of Jamaica's health and environment. As detailed in Section 2.9, waste disposal in Jamaica is typically done via disposal facilities that have not been specially engineered, but developments are being made to improve upon waste handling procedures.

There are many technical and control procedures that can be included in the environmentally sound management of a landfill such as the separation of municipal, medical and hazardous waste, the use of protective lining under the deposits, and the inclusion of sound wastewater management and treatment systems. The development

of a Specially Engineered Landfill (SEL) is guided by the guidelines under the Basel Convention.

It is critical that Jamaica promotes the reuse, recovery and recycling of mercury to minimise landfilling of contaminated wastes which increases the risk of mercury pollution in the environment. The complete phase-out of mercury waste disposal will not be an immediate action, and measures need to be put in place to ensure that controlled SELs with design features that prevent leaching of hazardous chemicals into the environment are implemented. These features include measures to prevent rainwater and groundwater inflow, to isolate different types of hazardous wastes, to drain, collect, test and treat leachate, and to maintain detailed records on all collected wastes.

Many household consumer products and medical waste products that contain mercury or mercury compounds, such as fluorescent light bulbs, batteries and thermometers end up at landfills mixed in with municipal waste. The predominant recommendation to reduce this mercury content in the landfills will coincide greatly with the recommendations for the nation to switch to the use of mercury-free alternative products. However, as mercury-added products are still currently circulating throughout society, these mercury control waste management procedures need to be applied in unison.

To assist in the prevention of mercury releases from the deposition of waste at landfills, the prevention of mercury emissions from the spontaneous combustion, and the intentional burning of municipal and medical waste, a controlled separation system is a significant step for the waste management authorities to undertake. The waste containing mercury can then be transported to an interim storage facility[18], final treatment or disposal site. At-home measures can also be encouraged for the public to separate out the waste products containing mercury and, thus nation-wide collection points and methods can be put in place. Training waste management personnel, as well as educating the general public on the identification of mercury-added products is an important inclusion in these separation methods. Other measures to further the mercury

[18] The operation of any interim storage facility would be governed by the Natural Resources Conservation (Permits and Licences)(Amendment) Regulations 2015

management in the waste handling sector include improving the regulations for controlled and uncontrolled landfill requirements, implementing fines on the informal burning of waste, and creating public awareness campaigns.

Regulated waste incineration facilities also contribute high mercury emissions. If the municipal and medical waste transferred to the incineration facilities did not include mercury-containing waste, emissions would have a much lower mercury concentration and, therefore, separation methods are also extremely beneficial in this aspect. As for the facility itself, control procedures to minimise mercury emissions and contamination can be set in place with regards to site selection, design and construction of future incinerators, as well as operation and monitoring procedures for existing incinerators. Flue gas stack controls and dust removal techniques, such as fabric filters can be added to the system to remove the mercury from emissions. Depending on the technique chosen, the mercury may be transferred to flue gas or fly ash, and therefore subsequently create a new solid or liquid mercury-containing waste stream. This stream then must be transported and correctly disposed of in an approved hazardous storage or treatment facility. If resources to invest in these new control technologies are low or unavailable, the modification of operation techniques such as furnace temperature, reagent type, and injection rate can be applied to assist with emission controls until the equipment can be acquired.

Periodic monitoring and evaluation are needed to ensure that these control methods are effectively reducing the mercury releases and emissions within the waste deposition and incineration sector. Each landfill and incineration facility can be required to submit periodic reports with required data to keep a track of the effectiveness of the measures being implemented. Successful cases can then be shared among the Caribbean region to encourage continued efforts regarding mercury waste management.

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Annex I: Members of the National Working on the Minamata Initial Assessment

Ministry of Economic Growth and Job Creation *(National Coordinator of MIA Project)*
Ms. Gillian Guthrie
Ms. Andrea Jones Bennett

Ministry of Health
Ms. Marsha Ann Palmer
Mr. Leonard Smith

National Environment and Planning Agency
Mr. Anthony McKenzie
Ms. Deborah Leeshung
Dr. Kerrine Senior
Ms. Bethune Morgan

Jamaica Bauxite Institute
Ms. Shanti Persaud

Mines and Geology Division
Mr. Suresh Bhalai

Pesticides Control Authority
Mr. Micheal Ramsay

Planning Institute of Jamaica
Ms. Gail Nelson

Government Chemist
Mr. Brian Stephenson

Statistical Institute of Jamaica
Ms. Janet Geoghagen Martin

Jamaica Customs Agency
Ms. Arlene Lawrence

Attorney General's Chambers
Ms. Candice Rochester
National Solid Waste Management Authority
Mr. Philip Morgan

Annex II: Project Stakeholder List

Organization	Contact Last Name	Contact First Name	Job Title	Address	Email	Telephone area code 876
BCRC-Caribbean	Khan	Ahmad	Former Director	#8 Alexandra Street, St Clair, Port-of-Spain Trinidad and Toba-go	Ahmad.khan@bcrc-caribbean.org	
	Batchasingh	Jewel	Director (Ag.)	#8 Alexandra Street, St Clair, Port-of-Spain Trinidad and Toba-go	Jewel.batchasingh@bcrc-caribbean.org	
Bureau of Stand-ards	Bremmer	Dwyte	Team Leader Chemistry Department	6 Winchester Road, Kingston 10	dbremmer@bsj.org.jm	926-3140-5
Carib Cement Company Ltd	Smith	Larissa	Quality Officer	Rockfort, Kingston	lsmith2@caribcement.com	928-6231, 446-3278
E. W. Abrahams and Sons	Abrahams	Michael	Managing Director	35 Hagley Park Rd, Kingston 10	e.w.abrahams@gmail.com	968-8406
Funeral Directors Association of Jamaica	Honeyghan	Melvin	President	104 Dalling Street, Sav-La-Mar Westmoreland	neljayhoneyghan@yahoo.com pat-mordecai@gmail.com	327-8487, 382-7807
Government Chemist Depart-ment	Daley	Yanique	Chemist	Hope Gardens, Old Hope Road, Kingston 6	ydaley@moh.gov.jm	927-1829-30,
	Stephenson	Brian	Government Chemist	Hope Gardens, Old Hope Road, Kingston 6	stephensonb@moh.gov.jm	927-1829-30, 317-8406

Organization	Contact Last Name	Contact First Name	Job Title	Address	Email	Telephone area code 876
Jamaica Bauxite Institute (JBI)	Persaud	Shanti	Environmental Officer	Hope Gardens Complex, Kingston 6	spersaud@jbi.org.jm	927-2073-9, 382-4798
	Bennett	Leighton	Scientific Officer	Hope Gardens Complex, Kingston 6	lbennett@jbi.org.jm	927-2073-9, 354-5442
Jamaica Customs Agency	Christian-Scott	Alicia	Manager	Myers' Wharf, Newport East, Kingston 15	alicia.scott@jacustoms.gov.jm	750-3074, 480-3888
	Lawrence	Arlene	Director (Safety and Health)	Myers' Wharf, Newport East, Kingston 15	arlene.lawrence@jacustoms.gov.jm	433-1542
	Nicely	Alwyn	Deputy CEO	Myers' Wharf, Newport East, Kingston 15	alwynnicely@jacustoms.gov.jm	
Jamaica Dental Association	Lyons-Morgan	Velmour	President		jdatoothtalk@gmail.com	927-9875
Jamaica Public Service Company Ltd. (JPSCo Ltd)	Dunn	Michelle	Environmental Manager		mdunn@jpsco.com	
	Stennett	Aldane	Manager Environmental Health and Safety	Spanish Town, St Catherine	astennett@jpsco.com	878-3702, 708-3335-7
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Organization	Contact Last Name	Contact First Name	Job Title	Address	Email	Telephone area code 876
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Jamalco	Spence	Andrea	EHS Manager	Halse Hall, Clarendon	andrea.spence@jamalco.com	469-4550
Jiuquan Iron and Steel (JISCO) (formerly Alpart)	Keith	Davis	Safety Manager	Halse Hall, Clarendon	keith.davis@alpart-jm.com	
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	Smith	Andrew		Nain, St Elizabeth	andrew.smith@alpart-jm.com	
Ministry of Economic Growth and Job Creation	Guthrie	Gillian	Senior Director	16 A Half-Way-Tree Road, Kingston 5	gillian.guthrie@megjc.gov.jm	633-7500
	Jones Bennett	Andrea	Director Projects & Enforcement	16 A Half-Way-Tree Road, Kingston 5	Andrea.jones@megjc.gov.jm	633-7500
	Khan	Oral	Chief Technical Director	16 A Half-Way-Tree Road, Kingston 5	oral.khan@megjc.gov.jm	633-7500
	Felix	Joanne	Director Environment	16 A Half-Way-Tree Road, Kingston 5	joanne.felix@hotmail.com	633-7500
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Ministry of Education	Bernard	Dean-Roy	Permanent Secretary	Heroes Circle, Kingston 4	dean-roy.bernard@moey.gov.jm jasmine.francis@moey.gov.jm	612-5810
Ministry of Health	De La Haye	Dr Winston	Chief Medical Officer	10-16 Grenada Way, Kingston 5	wdela@yahoo.com knightd@moh.gov.jm	633-8172

Organization	Contact Last Name	Contact First Name	Job Title	Address	Email	Telephone area code 876
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Ministry of Industry, Commerce, Agriculture and Fisheries (Inclusive of Trade Board)	Kong	Andre	Director (Fisheries Division)		gakong@micaf.gov.jm	
	Biggs-Allen	Grace-Ann		4 St. Lucia Avenue, Kingston 5	gallen@micaf.gov.jm	392-1881, 349-5656
	Dakin	Errol	Toxicologist/Analyst	193 Old Hope rd., Kingston 6	ecdakin@yahoo.com	977-2489, 459-5618
	Wedderburn	Stephen	Chief Technical Director	4 St. Lucia Avenue, Kingston 5	swedderburn@micaf.gov.jm	968-8730, 550-2280
	Kerr	Kelvin			kkerr@micaf.gov.jm	968-8687
Ministry of Local Government	Henry-Martin	Marsha	Permanent Secretary	85 Hagley Park Rd, Kingston 10	mhenry-martin@mlgcd.gov.jm	
Ministry of Science, Energy and Technology and/or Petrojam Ltd	Bandy	Betsy	Director, Policy, Planning, Development and Evaluation Division	PCJ Building, 36 Trafalgar rd., Kingston 10	bbandy@mset.gov.jm	920-4525, 564-6560
	Monroe	Setu		PCJ Building, 36 Trafalgar rd., Kingston 11	smonroe@mset.gov.jm	365-8770
Ministry of Transport and	Miller	Denis	Director Mines	138H Maxfield Avenue, Kingston 10	damiller@mtw.gov.jm	754-1900.

Organization	Contact Last Name	Contact First Name	Job Title	Address	Email	Telephone area code 876
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	Hedge	Hank	(Mines and Geology Division)		hank_hedge@hotmail.com	
National Commission on Science and Technology	Lewin	Patricia	Senior Technology Officer/Manager	PCJ Building, 36 Trafalgar rd., Kingston 10	plewin_ncst@mset.gov.jm	906-8433, 817-4969
National Environment and Planning Agency (NEPA)	Morgan	Bethune	Manager, Pollution Prevention Branch	10-11 Caledonia Avenue, Kingston 5	bethune.morgan@nepa.gov.jm	754-7540 ext 2323, 508-3949
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	Kirkland	Lisa	Manager, Air Quality	10-11 Caledonia Avenue, Kingston 5	lkirkland@nepa.gov.jm	754-7540 ext 2318, 351-9277
National Public Health Lab	Smith	Leonard	Chief Environmental Engineer	4th Floor, 21 Slipe Pen Road Kingston, Jamaica	leonard.smith@ymail.com	
National Solid Waste Management Authority (NSWMA)	Johnson	Sheenique		61 Half way Tree Road, Kingston	corporateservicesdirector@nswma.gov.jm	874-0110
	Gordon	Audley	Executive Director		executivedirector@nswma.gov.jm	
National Spatial	Richards	Rohan	Senior Director	191 Old Hope Road	rohan.richards@megjc.gov.jm	

Organization	Contact Last Name	Contact First Name	Job Title	Address	Email	Telephone area code 876
Data Management Division (NSDMD) MEGJC				Kingston 6		
	Williams	Walter		191 Old Hope Road Kingston 6	walter.williams@mwlecc.gov.jm	550-9047
National Water Commission (NWC), Wastewater Treatment	Daley	Patrick	Wastewater Manager		patrick.daley@nwc.com.jm tane-ca.brown@nwc.com.jm	
North East Regional Health Authority	Brown	Karen	Regional Environmental Health Officer	Ocean Village, Ocho Rios, St. Ann	karen.brown@nerha.gov.jm ka-renslims@yahoo.com	
Pesticides Control Authority	Ramsay	Michael	Registrar		ramsay@caribpesticides.net	
Pesticide Research Lab	Raymond	Reid	Quality Manager	UWI Mona, Kingston 7		974-4114, 770-8173, 364-3426
Petrojam Ltd.	Grindley	Floyd	General Manager		floyd.grindley@petrojam.com	923-8611
Statistical Institute of Jamaica	Geoghagen-Martin	Janet	Director Censuses, Demographic & Social Statistics Division	7 Cecelio Avenue, Kingston 10	sesu@statinja.gov.jm	630-1661, 578-1206
UC Rusal Jamaica Limited (Windalco)	Hutchinson	Ramon	EHS Manager	Kirkvine Works, Kirkvine P.O., Manchester	ramonhutchinson@gmail.com	903-5101, 508-9720
University of Technology	Johnson	Robert	Head of Chemistry Department	235 Old Hope Road, Kingston 6	rjohnson@utech.edu.jm	870-9585

Organization	Contact Last Name	Contact First Name	Job Title	Address	Email	Telephone area code 876
	Hylton	Kamilah	Faculty Dean (Science and Sport Division)	Science and Sport, University of Tech-nology, 235 Old Hope Road, Kingston 6	kshylton@utech.edu.jm	818-7464
University of the West Indies	Reid	Raymond	Quality Manager	UWI, Mona Kingston 7	rrreid1@gmail.com	426-6978
	Voutchkov	Prof. Mitko	Head of Physics Depart-ment	UWI, Mona Kingston 7	mitko.voutchkov@uwimona.edu.jm	
	Ricketts	Phylicia	Department of Physics	UWI, Mona Kingston 7	phylrick1@hotmail.com	880-4993
	Porter	Roy	Head of Chemistry De-partment	2 Plymouth Cres-cent, Mona, Kingston 7	roy.porter@uwimona.edu.jm	927-1910, 970-6082, 792-3856
	Maxam	Ava	Deputy Director of UWI GeoInformatics Institute	UWI, Mona Kingston 7	amaxam@monainformatixltd.com	977-3160
	Hoo Fung	Leslie	Research Scientist (International Centre for Environmental and Nu-clear Sciences (ICENS))	2 Anguilla Close, UWI Campus, Kingston 7	leslie.hoofung@uwimona.edu.jm	927-1777, 352-5589

Annex III: Stakeholder Questionnaires

Questionnaire for Power Station
Minamata Initial Assessment Project

NAME			
COMPANY NAME (IF APPLICABLE)			
ADDRESS			
CONTACT INFORMATION	PHONE	MOBILE	EMAIL

Please provide current and accurate information in the spaces provided below.

Power from refined oil

Concentration of mercury (mg mercury/tonne)	Oil used (tonnes/year) (2014)	Mercury release to air, land, water, etc is dependent on the type of emissions controls present. Output Scenario
	-Heavy Fuel Oil -Diesel	1. Oil Combustion Facility with no emissions controls ☐ 2. Oil Combustion Facility with PM control using an ESP or scrubber ☐ 3. Power plants with cESP and FGD ☐
		Other:

Abbreviations: PM – Particulate Matter (dust), ESP – Electrostatic Precipitators, cESP – (coldside) Electrostatic Precipitators, FGD – Flue Gas Desulfurization

Power from natural gas

Is natural gas refined in Jamaica? Yes ☐ No ☐

Natural gas used raw ☐ or pre-cleaned ☐ or both ☐

Concentration of mercury (µg mercury/Nm^3 gas)	Gas (Nm^3/year) (projection)	Mercury release to air, land, water, etc
		100 % air

Thank you for taking the time to complete this survey

Questionnaire for Fuels
Minamata Initial Assessment Project

NAME			
COMPANY NAME (IF APPLICABLE)			
ADDRESS			
CONTACT INFORMATION	PHONE	MOBILE	EMAIL

Please provide current and accurate information in the spaces provided below.

Crude oil refining

Origin of crude oil	Concentration of mercury (mg mercury/tonne)	Crude oil (tonnes/year)	Year	Mercury release to air, land, water, etc
				25 % air, 1 % water, 15 % sector specific treatment/disposal

Asphalt

Concentration of mercury (mg mercury/tonne)	Oil (tonnes/year)	Year	Mercury release to air, land, water, etc
			100 % air

Refined oil used for transportation

Number of gasoline retailers	Concentration of mercury (mg mercury/tonne)	Gasoline and Diesel (tonnes/year)	Year	Mercury release to air, land, water, etc
		-Gasoline **-Diesel**		25 % air, 1 % water, 15 % sector specific treatment/disposal

Liquified Petroleum Gases

Concentration of mercury (mg mercury/tonne)	LPG (tonnes/year)	Year	Mercury release to air, land, water, etc
			100 % air

Thank you for taking the time to complete this survey

Questionnaire for Alumina Production from Bauxite
Minamata Initial Assessment Project

NAME			
COMPANY NAME (IF APPLICABLE)			
ADDRESS			
CONTACT INFORMATION	PHONE	MOBILE	EMAIL

Please provide current and accurate information about alumina production from bauxite in the spaces provided below.

Concentration of mercury (mg mercury/tonne)*	Bauxite used (tonnes/year)	Year 2015/2016	Mercury release to air, land, water, etc*
			15 % air, 10 % water, 65 % general waste, 10 % sector specific treatment/disposal

* default data from the Inventory Level 2 UN Environment toolkit

1. What were the districts mined and the concentration of mercury observed in the respective ore?

   _____

   _____

   _____

2. How is mercury waste treated?

   _____

3. How do you generate power? Refined oil ☐ coal ☐ ☐

If refined oil

Origin of oil Petrojam or Imported (from where) or both	**Concentration of mercury (mg mercury/tonne)**	**Oil used (tonnes/year)**	**Year**	**Mercury release to air, land, water, etc is dependent on the type of emissions controls present.** **Output Scenario**
				1. Oil Combustion Facility with no emissions controls ☐ 2. Oil Combustion Facility with PM control using an ESP or scrubber ☐ 3. Power plants with cESP and FGD ☐

Abbreviations: PM – Particulate Matter (dust), ESP – Electrostatic Precipitators, cESP – (coldside) Electrostatic Precipitators, FGD – Flue Gas Desulfurization

If Coal

4. Below 300 MW thermal boiler capacity ☐
5. Above 300 MW thermal boiler capacity ☐
6. Is there pre-combustion coal wash? Yes ☐ No ☐

Origin of coal	**Type of coal**	**Concentration of mercury (g mercury/tonne)**	**Coal used (tonnes/year)**	**Year**	**Mercury release to air, land, water, etc is dependent on the type of emissions controls present.** **Output Scenario**
					Level 0: None ☐ Level 1: Particulate matter simple APC: ESP/PS/CYC ☐ Level 2: Particulate matter (FF) ☐ Level 3: Efficient APC: PM+SDA/wFGD ☐ Level 4: Very efficient APC: PM+FGD+SCR ☐ Level 5: Mercury specific filters ☐
					Other:

Abbreviations: APC- Air pollution control; CYC – cyclones; DS – Dry scrubber; ESP – Electrostatic precipitator; FF - Fabric filter (or "bag filter"); FGD – Flue gas desulfurization; PM – Particulate matter (or PM filter); PS - Particle scrubber; SCR - Se-lective catalytic reduc-tion; SD - Spray dryer; SDA - Spray dryer adsorber; SNCR - Selective non-catalytic re-duction; wFGD – Wet flue gas desulfurization.

Thank you for taking the time to complete this survey

Questionnaire for Cement Industry
Minamata Initial Assessment Project

NAME			
COMPANY NAME (IF APPLICABLE)			
ADDRESS			
CONTACT INFORMATION	PHONE	MOBILE	EMAIL

Please provide current and accurate information in the spaces provided below (or tick the appropriate boxes).

Cement production

Is there co-incineration of waste? Yes ☐ No ☐

Raw materials used	Concentration of mercury in cement produced (g mercury/tonne)	Cement produced (tonnes/year)	Year	Mercury release to air, land, water, etc is dependent on the type of emissions controls present. Output scenario
				1. With no filters ☐ 2. With filters and no filter dust recycling: 2a. Simple particle control (ESP / PS / FF) ☐ 2b. Optimized particle control (FF+SNCR / FF+WS / ESP+FGD / optimized FF) ☐ 2c. Efficient Hg pollution control (FF+DS / ESP+DS / ESP+WS / ESP+SNCR) ☐ 2d. Very efficient Hg pollution control (wet-FGD+ACI / FF+scrubber+SNCR) ☐ 3. With filters and filter dust recycling *2: 3a. Simple particle control (ESP / PS / FF) ☐ 3b. Optimized particle control (FF+SNCR / FF+WS / ESP+FGD / optimized FF) ☐ 3c. Efficient Hg pollution control (FF+DS / ESP+DS / ESP+WS / ESP+SNCR) ☐ 3d. Very efficient Hg pollution control (wet-FGD+ACI/FF+scrubber+SNCR) ☐
				Other:

Abbreviations: ACI – Activated carbon injection; DS – Dry scrubber; ESP – Electrostatic precipitator; FF - Fabric filter (or "bag filter"); FGD – Flue gas desulfurization; PM – Particulate matter (or PM fil-ter); PS - Particle scrubber; SCR - Selective catalytic reduction; SD - Spray dryer; SDA - Spray dryer adsorber; SNCR - Selective non-catalytic reduction; wetFGD – Wet flue gas desulfurization; WS – Wet scrubber.

Waste Incineration

Municipal/general waste is incinerated? Yes ☐ No ☐

Hazardous waste is incinerated? Yes ☐ No ☐

Medical waste is incinerated? Yes ☐ No ☐

Sewage sludge is incinerated? Yes ☐ No ☐

Types of waste incinerated	**Concentration of mercury in incinerated waste (g mercury/tonne)**	**Waste incinerated (tonnes/year)**	**Mercury release to air, land, water, etc is dependent on the type of emissions controls present.** **<u>Output scenario</u>**
			1. No emission reduction devices ☐ 2. PM reduc, simple ESP, or similar ☐ 3. Acid gas control with limestone (or similar acid gas absorbent) and downstream high efficiency FF or ESP PM retention ☐ 4. Mercury specific absorbents and downstream FF ☐
			Other:

Abbreviations: ESP – Electrostatic precipitator; FF - Fabric filter (or "bag filter"); PM – Particulate matter (or PM fil-

How do you generate power? Refined oil ☐ coal ☐ ☐

If refined oil

Origin of oil Petrojam or Imported (from where) or both	**Concentration of mercury (mg mercury/tonne)**	**Oil used (tonnes/year)**	**Year**	**Mercury release to air, land, water, etc is dependent on the type of emissions controls present.** **Output Scenario**
				7. Oil Combustion Facility with no emissions controls ☐ 8. Oil Combustion Facility with PM control using an ESP or scrubber ☐ 9. Power plants with cESP and FGD ☐

Abbreviations: PM – Particulate Matter (dust), ESP – Electrostatic Precipitators, cESP – (coldside) Electrostatic Precipitators, FGD – Flue Gas Desulfurization

If Coal

Below 300 MW thermal boiler capacity ☐

Above 300 MW thermal boiler capacity ☐

Is there pre-combustion coal wash? Yes ☐ No ☐

Origin of coal	**Type of coal**	**Concentration of mercury (g mercury/tonne)**	**Coal used (tonnes/year)**	**Year**	**Mercury release to air, land, water, etc is dependent on the type of emissions controls present.** **Output Scenario**
					Level 0: None ☐ Level 1: Particulate matter simple APC: ESP/PS/CYC ☐ Level 2: Particulate matter (FF) ☐ Level 3: Efficient APC: PM+SDA/wFGD ☐ Level 4: Very efficient APC: PM+FGD+SCR ☐ Level 5: Mercury specific filters ☐
					Other:

Abbreviations: APC- Air pollution control; CYC – cyclones; DS – Dry scrubber; ESP – Electrostatic precipitator; FF - Fabric filter (or "bag filter"); FGD – Flue gas desulfurization; PM – Particulate matter (or PM filter); PS - Particle scrubber; SCR - Se-lective catalytic reduc-tion; SD - Spray dryer; SDA - Spray dryer adsorber; SNCR - Selective non-catalytic re-duction; wFGD – Wet flue gas desulfurization.

Any chemical data available for the coal? Yes ☐ No ☐

Thank you for taking the time to complete this survey

Questionnaire for Lime Production
Minamata Initial Assessment Project

NAME			
COMPANY NAME (IF APPLICABLE)			
ADDRESS			
CONTACT INFORMATION	PHONE	MOBILE	EMAIL

Thank you for taking the time to complete this survey

Please provide current and accurate information in the spaces provided below.

Concentration of mercury in lime produced (mg mercury/tonne)	**Lime produced (tonnes/year)**	**Year**	**Mercury release to air, land, water, etc (*suggest breakdown- if possible*)**
			% air, % water, % land, % products, % general waste, % sector specific treatment/disposal

Questionnaire for Customs Division
Minamata Initial Assessment Project

NAME			
COMPANY NAME (IF APPLICABLE)			
ADDRESS			
CONTACT INFORMATION	PHONE	MOBILE	EMAIL

Please submit this data within two (2) weeks of receipt of this correspondence.

Thank you for taking the time to complete this survey.

Please fill in the table below with the required details on the categories of measuring devices imported in 2015 and 2016, where applicable:

	Item	Relevant HS Codes	Country of Origin, if available	g Hg/item, if available	Units imported in 2015	Units imported in 2016
1	Mercury in flasks of a net content of 34,5 kg "standard weight", of a fob value per flask of <= € 224	2805 40 10				
2	Mercury (excl. in flasks of a net content of 34,5 kg "standard weight", of a fob value per flask of <= € 224)	2805 40 90				
3	Amalgams of precious metals	2843 90 10				
4	Compounds, inorganic or organic, of mercury (excl. amalgams)	2852 00 00				
5	Inorganic compounds, n.e.s.; amalgams (excl. of precious metals)	2853 00 90				
6	Clinical thermometer containing mercury	9025 1120				
7	Clinical thermometer mercury free	9025 1920				
8	Ambient air thermometer containing mercury	9025 1180				
9	Ambient air thermometer mercury free	9025 1920				
10	Industrial and special application thermometers containing mercury	9025 1180				
11	Glass thermometers with Hg for laboratories	9025 1180				
12	Glass thermometers Hg free for laboratories	9025 1920				
13	Barometers/manometers containing mercury	9025 8020				
14	Barometers/manometers mercury free	9025 8020				

15	Hydrometers, pyrometers, hygrometers, etc., containing mercury and combinations excl. 9025 1120 and 9025 1180	9025 8080				
16	Hydrometers, pyrometers, hygrometers, etc., mercury free and combinations excl. 9025 1920	9025 8040				
17	Instrument/apparatus to measure or check the pressure of liquids/gases mercury free	9026 2000				
18	Instrument/apparatus to measure or check the pressure of liquids/gases containing mercury	9026 2000				
19	Spectrometers, spectrophotometers and spectrographs using optical radiations, such as UV, visible, IR	9027 30 00				
20	Instruments and apparatus for physical or chemical analysis, using UV, visible or IR optical radiations (exlc. spectrometers, spectrophotometers, spectrographs and gas or smoke analysis apparatus)	9027 50 00				
21	Sphygmomanometers mercury free (medical blood pressure gauges)	9025 8020				
22	Sphygmomanometers containing mercury (medical blood pressure gauges)	9025 8020				
23	Thermostats mercury free	9032 1000				
24	Thermostats containing mercury	9032 1000				
25	Discharge lamps, fluorescent, hot cathode with double ended cap	8539 3110				
26	Discharge lamps, fluorescent, hot cathode excluding with double ended cap	8539 3190				
27	Mercury or sodium vapour lamps; metal halide lamps	8539 3200				
28	Low energy consumption lamps	8539 3910				

29	Discharge lamps, other than ultra-violet, low energy and fluores-cent lamps	8539 3990				
30	Ultra-violet or infra-red lamps excl. arc lamps	8539 4900				
31	Manganese dioxide primary cells or batteries	8506 1000				
32	Mercuric oxide primary cells or batteries	8506 3000				
33	Silver oxide primary cells or batteries	8506 4000				
34	Lithium primary cells or batteries	8506 5000				
35	Air-zinc primary cells or batteries	8506 6000				
36	Other primary cells/batteries	8506 8000				
37	Laptops	847 130				
38	Cell Phones	851 712				
39	LCD Screens	8528 5900				
40	LC Screens	8528 7390				
41	Cosmetics containing mercury					
42	Paint containing mercury					
43	Pesticides and biocides containing mercury					
44	Pharmaceuticals containing mercury					

Questionnaire for Dental Sector
Minamata Initial Assessment Project

NAME			
COMPANY NAME (IF APPLICABLE)			
ADDRESS			
CONTACT INFORMATION	PHONE:	MOBILE:	EMAIL:

1. **Which do you use in your dental practice?**

   ☐ Elemental mercury (from a dispenser)

   ☐ Pre-capsulated mercury

   ☐ None

2. **Can you indicate the dental amalgam supplier to your dental practice?**

_____

3. **For the past year (1), kindly indicate the following information where applicable:**

Years	Number of Old Amalgams Re-moved	Number of New Amalgams Placed
2016		

4. **What type of chair side trap filter do you use?**

- ☐ Reusable
- ☐ Disposable

5. **How do you manage your waste from chair side traps? (please tick all that are applicable)**

- ☐ Recycle
- ☐ General garbage
- ☐ Biohazard Waste
- ☐ Wash down sink
- ☐ Don't know
- ☐ Other (please explain)_____

Please submit this data within two (2) weeks of receipt of this correspondence.

Thank you for taking the time to complete this survey.

Questionnaire for <u>Waste Incineration</u>
Minamata Initial Assessment Project

NAME			
COMPANY NAME (IF APPLICABLE)			
ADDRESS			
CONTACT INFORMATION	PHONE	MOBILE	EMAIL

Please provide current and accurate information in the spaces provided below (or tick the appropriate boxes).

Municipal/general waste is incinerated? Yes ☐ No ☐

Hazardous waste is incinerated? Yes ☐ No ☐

Medical waste is incinerated? Yes ☐ No ☐

Sewage sludge is incinerated? Yes ☐ No ☐

Types of waste incinerated	**Concentration of mercury in incinerated waste (g mercury/tonne)**	**Waste incinerated (tonnes/year)**	**Mercury release to air, land, water, etc is dependent on the type of emissions controls present.** **<u>Output scenario</u>**
			1. No emission reduction devices ☐ 2. PM reduc, simple ESP, or similar ☐ 3. Acid gas control with limestone (or similar acid gas absorbent) and downstream high efficiency FF or ESP PM retention ☐ 4. Mercury specific absorbents and downstream FF ☐

Abbreviations: ESP – Electrostatic precipitator; FF - Fabric filter (or "bag filter"); PM – Particulate matter (or PM filter).

Thank you for taking the time to complete this survey

Questionnaire for Waste Deposition

Minamata Initial Assessment Project

NAME			
COMPANY NAME (IF APPLICABLE)			
ADDRESS			
CONTACT INFORMATION	PHONE	MOBILE	EMAIL

Please provide current and accurate information in the spaces provided below (or tick the appropriate boxes).

Are there controlled landfills/deposits? Yes ☐ No ☐

Is there informal dumping of general waste? Yes ☐ No ☐

Concentration of mercury in waste (g mercury/tonne)	Waste land-filled/dumped (tonnes/year)	Year	Mercury release to air, land, water, etc is dependent on the type of emissions controls present.
			Controlled landfill 1 % air, 0.01 % water Informal dumping 10 % air, 10 % water, 80% land

Thank you for taking the time to complete this survey

Questionnaire for <u>Waste Water Treatment</u>
Minamata Initial Assessment Project

NAME			
COMPANY NAME (IF APPLICABLE)			
ADDRESS			
CONTACT INFORMATION	PHONE	MOBILE	EMAIL

Please provide current and accurate information in the spaces provided below (or tick the appropriate boxes).

Origin of waste water	**Concentration of mercury in waste water (mg mercury/m^3)**	**Waste water (m^3/year)**	**Mercury release to air, land, water, etc is dependent on the type of emissions controls present. <u>Output scenario</u>**
			1. No treatment; direct release from sewage pipe ☐ 2. Mechanical treatment only ☐ 3. Mechanical and biological (activated sludge) treatment; no land application of sludge ☐ 4. Mechanical and biological (activated sludge) treatment; 40% of sludge used for land applicatio ☐

Thank you for taking the time to complete this survey

Questionnaire for Funeral Homes
Minamata Initial Assessment Project

NAME			
COMPANY NAME (IF APPLICABLE)			
ADDRESS			
CONTACT INFORMATION	PHONE	MOBILE	EMAIL

Please provide current and accurate information in the spaces provided below.

Concentration of mercury (g mercury/corpse)	Corpse buried/year	Corpse cremated/year

Thank you for taking the time to complete this survey

Annex IV: Inventory Spreadsheet

The UNEP Toolkit Calculation Spreadsheet is available at the following link:

http://www.bcrc-caribbean.org/what-we-do/minamata-convention-on-mercury/jamaica-minamata-initial-assessment-2018/

If any issues arise in accessing link, please contact the BCRC-Caribbean via email at: info@bcrc-caribbean.org