NATIONAL REPORT

LEAD IN SRI LANKA'S NEW ENAMEL HOUSEHOLD PAINTS

September 2013

European Union

Centre for Environmental Justice

IPEN
a toxics-free future

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Lead in Sri Lanka´s New Enamel Household Paints

September 2013

Produced as part of the Asian Lead Paint Elimination Project
Supported by the European Union's SWITCH Asia Program

Printed on unbleached paper with vegetable based ink

Layout: Hemantha Withanage | printed by Sithru Graphics | Photo: Dilena Pathragoda

National Report

Lead in Sri Lanka´s New Enamel Household Paints

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Acknowledgment

We acknowledge the paint manufacturers and retailers who provided information on the paint market.

We acknowledge the European Union for providing funding for the effort of lead paint elimination in Sri Lanka, including this study. We also acknowledge the Swedish Environment Protection Agency, Swedish public development cooperation aid through the Swedish Society for Nature Conservation (SSNC), for providing financial contribution for conducting this study.

Also acknowledge IPEN project team for their contribution in preparation of this report. Mr. Bjorn Beeler of IPEN, Martin Salmonsson of the Asian Lead Elimination Project, the CEJ team; Mr. Hemantha Withanage, Mr. Dilena Pathragoda, Mr. Gamini Piyarathne, Miss. Oshani Sanjeewani, Miss. Ruwini Jayawardene, Mrs. Shanika Lokuruge, Miss. Indu Wattege and Mrs. Nilmal Wickramasinghe who helped in numerous ways to collect paint samples and preparation for testing.

Contents

1.	Foreword	01
2.	Executive Summary	02
3.	Introduction and Background to the Lead Paint Issue	04
	a. Lead Exposure to Children and its Health Effects	04
	b. International Context	05
4.	Sri Lankan Framework for Eliminating Lead Paint	07
5.	Major Paint Brands in Sri Lanka	08
6.	Materials and Methods	09
7.	Paint Test Results	10
	a. Lead Concentration by Color	12
	b. Lead Concentration by Brand	13
	c. Lead Concentrations in 2013 Compared to 2009	14
8.	Discussion and Recommendations	
	a. Discussion	16
	b. Recommendations	17
9.	Appendix I	18
10.	Appendix II	21

1. Foreword

This report presents new data on the lead content of enamel household paints for sale on the Sri Lankan market. This is the second time household paints have been analyzed in Sri Lanka to determine their total lead content. An earlier, more limited study was conducted in 2009. In this report, we detail findings from the most recent analysis of the lead content in household paints and compare these results with results from the 2009 study. We also review national policy frameworks that are in place to ban or restrict the national manufacture, import, sale and use of leaded household paints and changes in lead levels in paints that may have resulted from changes in that regulatory framework since the previous study.

The report also presents background information on why the use of household paints with high lead content is a source of serious concern, especially to children's health. And it proposes recommendations for taking action to protect children and others from lead in paint.

The report was prepared by Centre for Environmental Justice (CEJ) with support and assistance from the Asian Lead Paint Elimination Project. The Asian Lead Paint Elimination Project has been established to eliminate lead in paint and raise widespread awareness among business entrepreneurs and consumers about the adverse human health impacts of lead-based decorative paints, particularly on the health of children under six years old.

The Asian Lead Paint Elimination Project is being implemented by IPEN over a period of three years in seven countries (Bangladesh, India, Indonesia, Nepal, Philippines, Sri Lanka, and Thailand) with funding from the European Union (EU) totaling €1.4 million. While this publication has been produced with the assistance of the European Union, the contents of the publication are the sole responsibility of Centre for Environmental Justice together with IPEN, and can in no way be taken to reflect the views of the European Union. In addition, this document was produced with financial contributions from the Swedish Environment Protection Agency, Swedish public development co-operation aid through the Swedish Society for Nature Conservation, SSNC. The views herein shall not necessarily be taken to reflect the official opinion of any of these donors, including SSNC or its donors.

Centre for Environmental Justice (CEJ) is a social service environmental organization that provides free legal advice and science education for communities. CEJ has extensive experience in conducting awareness campaigns on Persistent Organic Pollutants, lead in household paints, mercury and other heavy metals, electronic waste disposal and climate change factors. CEJ has undertaken several public interest litigations in the past that have led to the successful establishment of genetically modified food labeling regulations in Sri Lanka as well as standards for lead minimization in paints.

IPEN is an international NGO network of health and environmental organizations from all regions of the world in which Centre for Environmental Justice participates. IPEN is a leading global organization working to establish and implement safe chemicals policies and practices to protect human health and the environment. Its mission is a toxics-free future for all. IPEN helps build the capacity of its member organizations to implement on-the-ground activities, learn from each other's work, and work at the international level to set priorities and achieve new policies.

The European Union is made up of 27 Member States who have decided to gradually link together their know-how, resources and destinies. Together, during a period of enlargement of 50 years, they have built a zone of stability, democracy and sustainable development, while maintaining cultural diversity, tolerance and individual freedom. The European Union is committed to sharing its achievements and its values with countries and people beyond its borders.

2. Executive Summary

From September 2012 to January 2013, the Sri Lankan NGO, Centre for Environmental Justice purchased 118 cans of house paints from stores covering most regions of Sri Lanka. Of these paints, samples from 94 oil-based paints, representing 57 brands sold in the Sri Lankan market, were sent to be analyzed for lead content by a laboratory in Italy.

2. a. Background

Lead is a toxic metal, which can be found in paints when a paint manufacturer intentionally adds one or more lead compound to the paint as pigments or for some other purpose such as drying agents and catalysts in oil-based paints.

Good, cost-effective substitutes for all the lead compounds that are used in making household paints have been widely available and in use in the industrialized countries since the 1980's and before. Any paint manufacturer that currently produces household paints with added lead compounds could easily reformulate its paints using these substitutes with very little (if any) impact on the characteristics of the paints they produce or on the price. There is no good reason for a paint manufacturer to continue producing paints with added lead compounds, especially since the childhood health hazards associated with lead paint are very serious and well-documented.

Children are particularly vulnerable to lead. The major pathway of exposure is usually through the ingestion of lead-contaminated dust and soil through normal hand to mouth activity common in young children. Children also absorb more of the ingested lead than adults and their developing neurological systems are particularly sensitive to the effects of lead exposure.

The World Health Organization (WHO) has cited the dangers of lead exposure, saying: "Children are particularly vulnerable to the neurotoxic effects of lead, and even relatively low levels of exposure can cause serious and, in some cases, irreversible neurological damage."

Since January 1, 2013, Sri Lanka has a mandatory standard in force which limits the lead content of household paints to 90 ppm and 600 ppm depending on a category. This standard is set in reference to the Sri Lanka Standards Institution (SLSI) standard specifications for paints, and replaced the voluntary standard previously in place.

2. b. Study Results

Analyzed Samples: Only 47 of the 94 (50%) analyzed paints had lead levels low enough to be sold legally in Sri Lanka (<600 ppm) and a quarter of all paints (24 of 94 paints) analyzed had dangerously high levels of lead (above 10,000 parts per million lead, dry weight).

Colors: The yellow colored paint samples, red colored and the green colored paint samples most frequently contained high lead levels. In addition, one white paint sample contained unusually high level of lead compared to other countries. 16 of 22 of the yellow samples, all of the 6 green samples and 12 of 27 of the red samples contained lead levels above 600 ppm. In general white paint samples contained the lowest levels of lead, even when other colors from the same brand had high lead levels. However, 31% of the white paint samples contained levels above 600 parts per million (ppm).

Paint Brands: 63% of paint brands sold in Sri Lanka and that were analyzed do not meet the current Sri Lankan Standard for lead in paint but were still available on the Sri Lankan paint market. 36 of the 57 paint brands included in the study sold paints with lead levels that exceeded 600 ppm. 21 brands sold paints with dangerously high lead levels above 10,000 ppm. In addition, two brands included paints with lead levels even exceeding 100,000 ppm.

Comparison with 2009 study: A smaller percentage of paint samples showed high levels of lead in 2013 compared to 2009. The percentage of samples with concentrations of lead between 600 and 10 000 ppm and greater than 10 000 ppm was observed to have decreased between 2009 and 2013, while the percentage of samples having low levels of lead (below 90 ppm) has increased in 2013.

2. c. Conclusions and Recommendations

This study shows that paints with high levels of lead are still available on the Sri Lankan market, even with the existing law limiting the allowed level of lead to 600 ppm. However, 37% (35 out of 94) of the samples analyzed contained very low lead levels (below 90 ppm), which suggests that the technology to produce unleaded paints is widely available in Sri Lanka. When comparing the current results with results from the 2009 study, it is clear that some manufacturers reduced or removed lead from their paint production. These companies are the ones that participated in awareness raising activities conducted by CEJ after the 2009 study. This indicates that awareness-raising activities are essential to make the implementation of the legislation limiting lead levels in household paints successful.

CEJ recommends the relevant government authorities, paint manufacturers, raw material suppliers, retailers and the public to continue efforts to protect the Sri Lankan children in the following ways:

- Enforce the existing law. Additional effort needs to be taken to make paint manufacturers aware of the paint standard and to regularly monitor paints for lead content.
- Define custom regulations to limit the import of leaded paints, leaded raw materials for paints, toys painted with leaded paints and other items available for children that may contain leaded paints.
- Establish forums of various stakeholders such as paint raw material suppliers where paint manufacturers can get assistance for substitute paint components needed for phasing out the use of leaded materials in their paint production.
- Conduct awareness raising activities among raw material suppliers and paint manufacturers, in order to encourage increased availability and use of lead-free raw materials.
- Require paint can labels to alert users to the hazards of lead-contaminated dust and other materials when previously painted surfaces are scraped or sanded in preparation for repainting.
- Raise public awareness on health hazards of lead, and establish a monitoring program for blood lead levels in Sri Lanka.
- Switch to safer non-lead alternatives for paint ingredients and prevent the use of lead soldered paint cans. These substitute materials are available in the market at an affordable price.
- Always ask for un-leaded paint to protect the health of the children as well as all the members of the family.

3. Introduction and Background to the Lead Paint Issue

Lead is a toxic metal, which can be found in paints when a paint manufacturer intentionally adds one or more lead compound to the paint for some purpose. The lead compounds most commonly added to paint are pigments that give the paint its color. Lead compounds commonly used as paint pigments include: lead chromates, lead oxides, lead molybdates, and lead sulfates. These are added to produce bright colors such as yellow, red and green. Lead compounds may also be added to paint to serve as drying agents and catalysts in oil-based paints. These make the paint dry faster and more evenly. Lead-based corrosion resistance agents are sometimes added to paints that are used on metal surfaces in order to inhibit rust and corrosion. The most common of these is lead tetroxide, sometimes called red lead or minimum.

Good, cost-effective substitutes for all the lead compounds that are used in making household paints have been widely available since the 1980's and before in the industrialized countries. Any paint manufacturer that currently produces household paints with added lead compounds could easily reformulate its paints using these substitutes with very little (if any) impact on the characteristics of the paints they produce or on the price. There is no good reason for a paint manufacturer to continue producing paints with added lead compounds, especially since the childhood health hazards associated with lead paint are very serious and well-documented.

When a paint manufacturer does not intentionally add lead compounds in the formulation of its paints, the lead content of the paint will be very low – almost always less than 90 parts per million (total lead, dry weight). If a paint manufacturer is careful in selecting ingredients that do not contain lead as a contaminant, the lead content of the paint will often be as low as 10 parts per million or less.

In almost all recent cases where paints have been analyzed, water-based paints (sometimes called latex or acrylic paints) do not contain added lead. On the other hand, in most developing countries and countries with economies in transition where paints have recently been analyzed for their lead content, many of the oil-based paints (sometimes called enamel paints) contain high lead content. For this reason, the current study, Lead in Sri Lankan Household Paints, selected to only analyze oil-based paints for lead content.

3. a. Lead Exposure to Children and its Health Effects

Children are not generally exposed to lead from paint while the paint is still in the can or even when the paint is being newly applied to a previously unpainted or uncoated surface. Rather, the lead exposure generally occurs after the lead paint has already dried on the wall or on the article that has been painted.

Painted surfaces age, weather, and chip with time. Any lead that is in the paint then enters indoor and outdoor dusts and soils in and around the painted home or building. Children have an innate curiosity to explore their world and engage in developmentally appropriate hand-to-mouth behavior. When playing in lead contaminated environments, the dust and soil that they ingest will carry lead. This is especially true for children in the six years and under age group, the group most easily harmed by exposure to lead. For example, a typical one to six year old child ingests approximately 100 milligrams of house dust and soil each day.[1]

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1. World Health Organization, 2010. Childhood Lead Poisoning, p.18. http://www.who.int/ceh/publications/leadguidance.pdf

Paint chips can be especially harmful since their lead content can be much higher than what is typically found in dust and soils. In some cases, children may pick up paint chips and put them into their mouth. In addition, when toys or other articles are painted with lead paint, children may chew on them and directly ingest the lead-contaminated dried paint. However, the most common way in which children ingest lead is thought to be through lead-containing dust.

Children and workers are especially at risk when surfaces that were previously painted with lead paint are repainted or disturbed by construction or other activities. Workmen may sand, dry scrape, grind, or in other ways disturb the old painted surface and produce large quantities of dust with very high lead content.

Exposure to lead is much more harmful to children than adults, and the health effects are generally irreversible and can have a lifelong impact.[2] The younger the child, the more harmful lead can be. The human fetus is the most vulnerable and a pregnant woman can transfer lead that has accumulated in her body to that of her developing child. That means that lead can poison several generations, and not only one person during active exposure.

- A child's brain undergoes very rapid growth, development and differentiation and lead interferes with this process. Brain damage caused by chronic, low-level exposure to lead during early years is irreversible and untreatable.
- Exposure to lead early in life can re-program genes, which can lead to altered gene expression and an associated increased risk of disease later in life.
- Gastrointestinal absorption of lead is enhanced in childhood. Up to 50 percent of ingested lead is absorbed by children, as compared with 10 percent in adults. (Pregnant women may also absorb more ingested lead than other adults). In those children who suffer from nutritional deficiencies, ingested lead is absorbed at an even more increased rate.

Children are more biologically susceptible to lead than adults for several reasons including:

Evidence of reduced intelligence caused by childhood exposure to lead has led the World Health Organization to list "lead caused mental retardation" as a recognized disease. WHO also lists it as one of the top ten diseases whose health burden among children is due to modifiable environmental factors.[3]

In recent years, medical researchers have been documenting significant health impacts on children from lower and lower lead exposures.[4] In response, the U.S. Centers for Disease Control and Prevention (CDC) and other authorities have concluded that there is no known acceptable lead exposure level for children.[5]

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2. World Health Organization, 2010. Childhood Lead Poisoning, p.12.

3. World Health Organization, 2006. Preventing disease through healthy environments, p. 6. http://www.who.int/quantifying_ehimpacts/publications/preventingdisease.pdf

4. Needleman, H., 2004. Lead Poisoning. Annu. Rev. Med. 55, 209–22. http://www.rachel.org/files/document/Lead_Poisoning.pdf

5. Scientific Opinion on Lead in Food, EFSA Panel on Contaminants in the Food Chain (CONTAM), EFSA Journal 2010. http://www.efsa.europa.eu/en/efsajournal/doc/1570.pdf

3. b. International Context

The use of lead in household paints is a matter of global concern. At the International Conference on Chemicals Management (ICCM) held in 2009, lead paints were identified by consensus to be an international priority issue of concern. In response to the ICCM decision, the United Nations Environmental Program (UNEP) and the World Health Organization (WHO) jointly initiated a global partnership to eliminate the use of lead compounds in paints in order to protect public health and the environment. This partnership is called the Global Alliance to Eliminate Lead Paint (GAELP), and its overall goal is to prevent children's exposure to lead via paints containing lead and to minimize occupational exposures to lead in paint. GAELP's broad objective is to phase out the manufacture and sale of paints containing lead and, eventually, to eliminate the risks from such paint

At the third meeting of the ICCM held in 2012, ICCM delegates agreed by consensus to call upon governments, civil society organizations, and the private sector to contribute to GAELP in various ways, including by:

- Raising awareness about the toxicity to human health from lead in paint including for young children, paint users, and the workers in paint production facilities;
- Filling information gaps by analyzing paints for their lead content in countries where little or no data is available;
- Promoting national regulatory frameworks, as appropriate, to stop the manufacture, import, export, sale and use of lead paints and products coated with lead paints;
- Encouraging paint manufacturing companies to substitute lead compounds added to paint with safer alternatives; and
- Establishing prevention programs to reduce exposure in and around housing, childcare facilities, schools and other buildings where lead paint has been used in the past.

4. The Sri Lankan Framework for Eliminating Lead Paint

Most highly industrial countries enacted laws, regulations or mandatory standards to protect the health of their people from lead exposure in the 1970's and 1980's. These laws generally prohibit the manufacture, import, sale or use of lead paint for interiors or exteriors of homes, schools and commercial buildings. In recent years, these regulations have become increasingly stringent. The standard adopted by the United States imposes an upper limit of 90 parts per million (ppm) on total lead (dry weight) for house paints and many other paint categories. Other countries have adopted mandatory limits in the range of 90 to 600 ppm total lead (dry weight). NGOs associated with the IPEN network generally promote the 90 ppm total lead standard as one that is fully achievable and maximally protective.

For decades, household paints produced for sale in highly industrial countries have not used added lead compounds as pigments, drying agents or for other purposes in recognition of the fact that there is no good reason to continue producing paints with added lead compounds, especially since the childhood health hazards associated with lead paint are very serious and well-documented.

Since January 1st, 2013, Sri Lanka has a mandatory standard in force which limits the lead content of household paints to 600 ppm. This standard is set in reference to the Sri Lanka Standards Institution (SLSI) standard specifications for paints, and replaced the voluntary standard previously in place.

The mandatory standard was set as a result of a campaign CEJ conducted based on the 2009 study of lead content of paints in Sri Lanka. In this campaign, CEJ went to the Supreme Court (Case No. 64/2011) requesting a mandatory standard for the sake of the health of the children in Sri Lanka. As a result, the Consumer Affairs Authority made a gazette notification (Gazette Extra Ordinary No 1725/30 on 30 September 2011) establishing new mandatory standards for lead levels in paint to take effect January 1, 2013.*

Accordingly; the established maximum permissible levels of total lead, for different paint categories are as follows;

Paints for Toys and Accessories for Children (soluble in HCl acid)	**- 90 mg/kg**
Enamel Paints	**- 600 mg/kg**
Emulsion Paints for Exterior use	**- 90 mg/kg**
Emulsion Paints for Interior use	**- 90 mg/kg**
Floor Paints	**- 600 mg/kg.**

1 mg/kg corresponds to 1 part per million (ppm)

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*Note: * The Gazette states that " no Manufacturer, Importer, Packer, Distributor or Trader shall manufacture, import and use or distribute, pack, store or sell or display for sale, expose for sale or offer for sale, wholesale or retail any paints unless such paints shall conform to the corresponding Total Lead Content given hereunder as specified by the Sri Lanka Standard Institution for such paints".*

5. Major Paint Brands in Sri Lanka

The Ministry of Industries' "list of industries registered under the Ministry of Industrial Development" lists approximately 27 paint manufacturers in Sri Lanka. Using various sources, CEJ identified 63 paint manufacturers active in Sri Lanka. However, a subsequent market survey conducted by CEJ found paint brands from only 55 manufacturers available on the Sri Lankan market.

In Sri Lanka, there are 7 large paint companies: CIC (Dulux/ Glidden), Lankem (Robbialac/ Rolac), Asian Paints (Royale/Apicolite/ Permoglaze), Causeway (Luxury/ Kenlux), Silicon Coatings (Nippolac/ Veron) and Macksons Lanka (Multilac/ Micron).

Availability of these paints varies depending on the geographical area and, in some areas of the country, small and medium manufacturers dominate the paint market.

6. Materials and Methods

In 2013, the Sri Lankan NGO Centre for Environmental Justice (CEJ), with help and support from the international NGO network IPEN, purchased 118 cans of paints. Of these paints, 94 oil-based paints were selected, and samples from these were sent for analysis. These 94 paints came from 57 different brands from stores in and around most provinces of Sri Lanka.

The 57 brands were manufactured from a total of 50 companies. In most cases, one white and one bright color paint, such as red, green or yellow, was selected. The availability of these paints in retail establishments suggests that they were intended to be used within home environments. Excluded were automotive and industrial paints that are not typically used for domestic housing applications or to paint toys. Of the 118 cans of paint purchased, the 94 cans of paints were selected for analysis of lead content by including samples from all oil-based paints, including two colors from every brand where available. Also included were brands of oil-based paints commonly used in a household environment such as anti-corrosives, lacquers and bright aluminum. The only paints not selected were additional colors of brands already included. Paint sample preparation kits containing individually numbered, untreated wood pieces, single-use brushes and stirring utensils made from untreated wood sticks were assembled and shipped to CEJ by staff of the IPEN partner NGO, Arnika, in the Czech Republic. Each paint was thoroughly stirred in the can and applied by a separate unused single-use brush to duplicate, individual, numbered, unused, wood pieces by CEJ staff.

Each stirring utensil and paintbrush was used only once, and care was taken to avoid cross contamination. After drying, the wood pieces were placed in individual plastic bags and shipped for analysis of lead content to Certottica laboratory in Italy.

Certottica is accredited by ACCREDIA – the Italian Accreditation System, which is the Italian National Accreditation Body appointed by the State. This laboratory also participates in the Environmental Lead Proficiency Analytical Testing (ELPAT) program operated by the American Industrial Hygiene Association under a program established by the US Environmental Protection Agency.

The laboratory scraped paint off the wood pieces they received. The paint was then weighed into a hot block digestion tube and the paint chips digested according to method CPSC-CH-E1003-09.1. A quantity of paint was removed from the sample by abrasion. The paint was placed in a beaker of borosilicate, in which were added 3 mL of HNO_3 and 1 mL of 30% H_2O_2. The beaker was first covered with a glass and then was heated on a hotplate (surface temperature of approximately 140 ° C, from 85 initially to 100 ° C) until most of the acid evaporated. This treatment was repeated twice more. The beaker containing the sample was removed from the plate and let cool to room temperature. The cover glass was then rinsed with a quantity of HNO_3 10% from 3 to 5 mL and the warm solution was left to evaporate slowly and the beaker cool to room temperature. Finally, 1 mL of HNO_3 was added to the residue, which was agitated to dissolve the soluble species. The walls of the beaker and the bottom of the cover glass were rinsed and the liquid was transferred into a flask and brought to volume with deionized water.

Lead in the digestates was analyzed by an Atomic emission spectrophotometer (ICP-AES), Thermo Scientific iCAP 6000 Series, using yttrium (2 mg/L) as internal standard.

The laboratory's lower limit of detection for the lead concentration in the paint samples is dependent on the amount of paint in the samples. Generally, for 100 mg of paint scraped off the wood pieces the lowest detection limit is 8 ppm, but for a smaller amount of paint the detection limit increases. Therefore, the lead content in five of the samples are reported as below a certain threshold ranging between 30 ppm and 6 ppm. However, these samples may in fact contain lead less lead than the threshold value, and no conclusion can be reached with regard to their relative lead concentrations more than it was below that threshold concentration.

7. Paint Test Results

A total of 94 paints from 57 brands purchased in different regions of Sri Lanka were analyzed for lead content. The details of the paints are listed in appendix 1 and the results illustrated in Figure 1.

Only 47 of the 94 (50%) analyzed paints had lead levels low enough to be legally sold n Sri Lanka and a quarter of all paints in the study contained dangerously high levels of lead.

The average concentration of lead in the analyzed paints was 11,600 parts per million (ppm), based on dry weight of the digested sample. The highest concentration detected was 131,000 ppm, i.e. 13.1% of the dry weight of the applied paint.

Extremely high lead concentrations above 100,000 ppm were found in samples from two paints from different brands, very high levels between 10,000 and 100,000 ppm were found in 22 of the paints analyzed; 23 of the paints contained high lead concentrations between 600 and 10,000 ppm, and 12 of the paints contained concentrations between 90 and 600. The other 35 paints had low (below 90 ppm) lead concentrations.

Lead Levels	*Number of paint samples*
Extremely high: Lead concentrations above 100, 000	2
Very high: Lead concentrations between 10,000 and 100,000 ppm	22
Unacceptable: Lead concentrations between 600 and 10,000 ppm	23
Meets Sri Lankan Standard: less than 600 ppm	47
Meets Sri Lankan Standard: Below 90 ppm *	35

Table 1: Number of Paint Samples with regard to the lead concentration

*Note: * When a paint manufacturer does not intentionally add lead compounds in the formulation of its paints, the lead content of the paint will be very low – almost always less than 90 parts per million (ppm) (total lead dry weight) and frequently much lower. If a paint manufacturer is careful in selecting ingredients that do not contain lead as a contaminant, the lead content of the paint will often be as low as 10 parts per million or less. IPEN and CEJ recommend 90 ppm as an achievable and protective goal for lead in paint worldwide.*

None of the fourteen paint cans with a label indicating a low lead content contained lead concentrations greater than 600 ppm.

However, four of these paints contained lead levels between 90-330 ppm and cannot justifiably be called lead free. In addition one paint sample with very high levels of lead (53,000 ppm) has the SLS certification (SLS - Sri Lankan Standard) indicating a low level of lead. The manufacture date of this paint can shows that this was produced when the SLS standard was still voluntary, which shows the importance of mandatory standards.

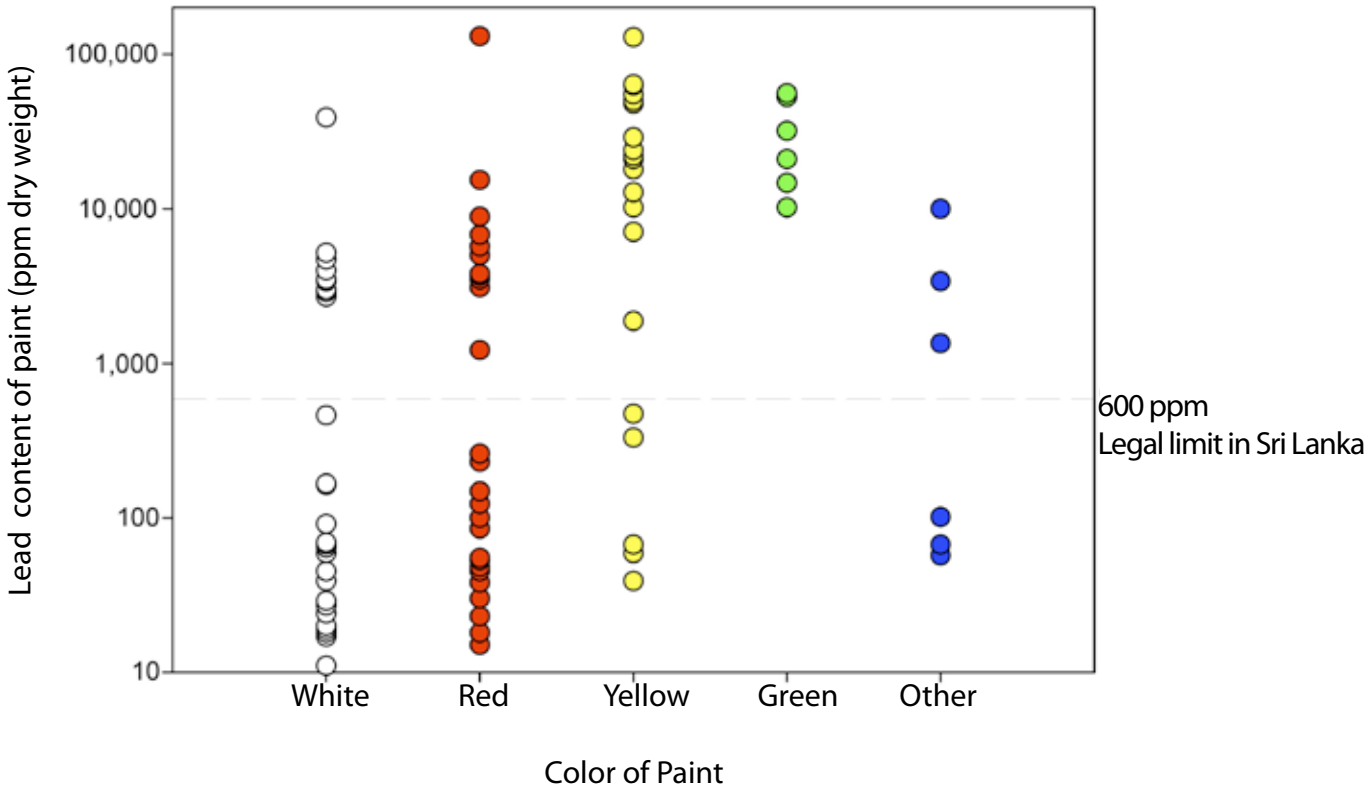

Figure 1: Lead levels of the analyzed paints.
Note: The y-axis is on a logarithmic scale, i.e. there is a tenfold increase in lead concentration between each major tick.

7. a. Lead concentration by color

The yellow colored paint samples, the green and the red colored paint samples most frequently contained high lead levels. (Table 2) 16 of 22 of yellow samples, all of the 6 green samples and 12 of 27 red samples contained lead levels above 600 ppm.

Samples from white paints contained unusually high levels of lead compared to other countries. In general white paint samples contain the lowest levels of lead, even when other colors from the same brand have high lead levels. However, 31% of white paint samples (10 out of 32) contained levels above 600 ppm. Although higher lead levels are usually found in the bright colors, it is also noteworthy that the only black sample has a lead level of 10,000 ppm (appendix 1).

Color	*Number of samples*	*% of samples above 600 ppm*	*% of samples above 10,000 ppm*	*Highest lead concentration*
White	32	31	3	39,000
Green	6	100	100	56,000
Red	27	44	7	131,000
Yellow	22	73	64	129,000
Other	7	43	0	10,000 (black)

Table 2: Lead levels grouped according to color of paint

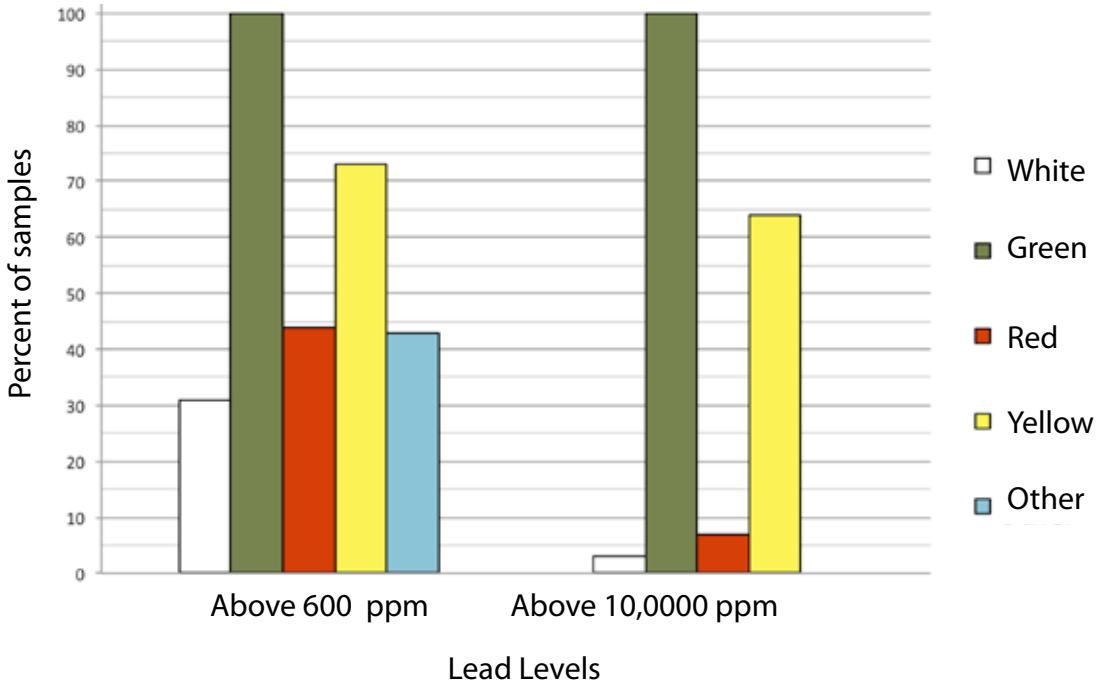

Figure 2: Lead levels grouped according to color of paints

7. b. Lead Concentration by Brand

63% (36 out of 57)of paint brands sold in Sri Lanka and that were analyzed do not meet the current Sri Lankan Standard for lead in paint but were still available in the Sri Lankan paint market.

36 of 57 paint brands included in the study sold paints with lead levels that exceeded 600 ppm. Twenty-one brands sold paints with dangerously high lead levels above 10,000 ppm and two brands sold paints with extreme lead levels exceeding 100,000 ppm. (Table 7, appendix II)

12 brands offered both leaded and un-leaded (< 600 ppm) paints.

All paints from 21 of the brands contained less than 600 ppm of lead in their analyzed samples.

Out of the 94 analyzed samples, 64 were purchased after the lead paint legislation came into force (1, January 2013). 35 of those 64 paints (55%) contained lead levels exceeding the Sri Lankan standard, 600 ppm. At the same time, 33% of these paints contained lead below 90 ppm, and shows that 90 ppm is an achievable target by Sri Lankan paint manufacturers. (Figure 3)

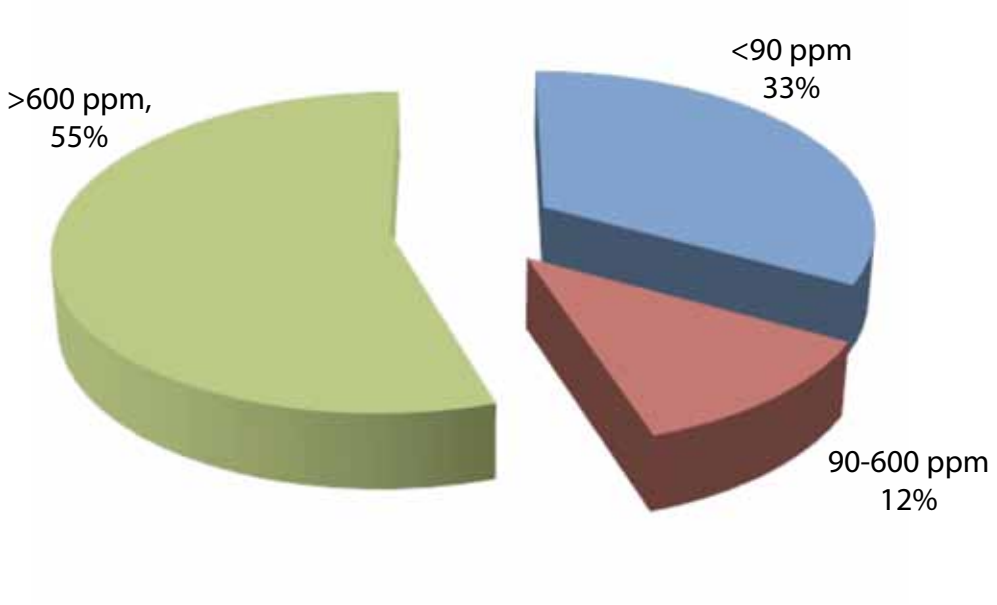

Figure 3: Percentage of samples purchased after 1, January 2013, grouped according to their lead content

In Sri Lanka, several types of oil-based paints are commonly used in a household environment, but are primarily not for painting the walls or floors. Because of the humid climate in Sri Lanka, anti-corrosives are commonly used on household metal surfaces as well as other metal paints (e.g. gold and aluminum) to decorate baby cots and other furniture. However, lead from these paints also constitutes a potential source for childhood exposure to lead. A selection of these types of paints was therefore included in the 94 samples of the study. (Table 3) The average for these paints (2,250 ppm) was much lower than that for the overall total of the 94 samples analyzed (11,600 ppm).

Type of paint	*Level of lead (ppm)*	*Color*
Anti-corrosive	5,700	Red
Anti-corrosive	5,000	Oxide red
Anti-corrosive	5,000	Red
Anti-corrosive	3,100	Red
Anti-corrosive	1,220	Red
Anti-corrosive	< 30	Red
Anti-corrosive	39	White
Bright aluminum	57	Silver
Gold paint	101	Gold
Average	2,250	

Table 3: Lead levels in other kind of paints used in a household environment

The results showed that the red anti-corrosives frequently contained high levels of lead, whereas the other metal paints (gold paint and bright aluminum) only contained low lead levels. The white anti-corrosive paint sample had a low lead content, which may indicate that white anti-corrosives are a better choice than red.

7. c. Lead concentrations in 2013 compared to 2009

A smaller percentage of paint samples showed high levels of lead in 2013 compared to 2009.

The percentage of samples with a concentration of lead between 600 and 10,000 ppm and greater than 10,000 ppm was observed to have decreased somewhat between 2009 and 2013 while the percentage of samples having levels of lead below 90 ppm has increased in 2013 (Table 4).

	No of paints analyzed	*% paints with lead levels below 90 ppm*	*% paints with lead levels over 600 ppm*	*% paints with lead levels over 10,000 ppm*	*Highest level detected (ppm)*
Year 2013	94	37	50	24	131,000
Year 2009	19	32	68	37	137,000

Table 4: Comparison of results from paint analyzes performed in 2013 and 2009.

The recent study analyzed a larger number of brands and varieties of paints compared to the study conducted in 2009. However, samples taken in 2013 from the brand C, shown to have high levels of lead in 2009, had greatly reduced lead levels in 2013. Lead content in the samples collected in 2013 from the two other brands had been reduced by 16% and 46% on average of all samples of the same brand. Samples from the fourth brand were low both times. (Table 5) When comparing individual samples brand A and brand B had both samples both with lead concentrations below 600 ppm and above 600 ppm in 2013, which indicates the significance of lead usage by color.

Brand	*Number of samples 2009*	*2009 Average Lead content (ppm)*	*Number of samples 2013*	*2013 Average Lead content (ppm)*
A	2	23,000	2	3,600
B	6	38,300	3	17,700
C	6	33,900	2	66
D	5	6.4	1	53

Table 5: Comparison of results from 2009 and 2013 for samples of the same brand

8. Discussion and Recommendations

8. a. Discussion

The regulated limit for lead levels in oil-based paints in Sri Lanka is now 600 ppm on a dry basis for total lead. However, approximately half the paints analyzed in this study contained lead at levels above this limit. This is possibly due to a lack of awareness among some paint manufacturers and retailers on the existing law as well as the hazardous effect of lead.

The same four brands analyzed in 2009 were also included in the current study, but fewer colors were analyzed. Only two of the eight samples included in the current study from these four brands contained lead at levels over 600 ppm, and one of these paints was manufactured before the regulation was established. The average lead concentration was either below 600 ppm or significantly reduced from 2009 to 2013 for these brands.

Following the 2009 study, CEJ conducted an awareness raising campaign among interested manufacturers on the hazards of using leaded ingredients in their paints. In the samples included in the current study, these manufacturers have removed or significantly reduced the levels of lead in their paints. Hence, proper implementation of the existing law along with awareness programs appears to be the best remedy for removing leaded paints from the market in Sri Lanka.

All paints analyzed from 33 of the 57 brands in this study contained legal levels of lead (below 600 ppm). It is worth noticing that the paints from 21 of these brands (i.e. 37% of all brands in the study) had very low lead levels (below 90 ppm).

Additionally, 12 of the brands offered both paints with low lead content (below 600 ppm) and paints with high lead levels. This shows that the technology necessary for producing unleaded paints is available in Sri Lanka, but is not consistently used by some companies. In addition, it shows that the majority (28of 50) of paint manufacturers in Sri Lanka have the ability to produce unleaded paints already.

Among anti-corrosive paints, only the red color contains lead concentrations above 600 ppm (Table 3). However, there is one red anti-corrosive paint with a lead concentration below 30 ppm, which indicates that these companies also have the technology to produce anti-corrosive paint without using lead compounds. Finally, the white anti-corrosive paint analyzed contained low lead levels (<90 ppm), which may indicate that this color is a better choice for household decorative paint for applications where anti-corrosives are necessary.

Some of the paint cans with labels indicating no added lead actually had lead levels between 90–330 ppm. Although this cannot be regarded as a safe level, this lead level is within the regulated limit for enamel paints in Sri Lanka and is likely due to impure paint ingredients rather than intentionally added lead . However, these labels were found only in 15% of the paints collected, and the no-lead statement is not confirmed by an independent party. Thus it will be important to implement a third party certification/ group certification program in the absence of proper implementation of the existing law in order to secure the children's health in Sri Lanka.

8. b. Recommendations

At the national level

- Enforce the existing law. Additional effort needs to be taken to make paint manufacturers aware of the paint standard and to regularly monitor paints for lead content.
- Define custom regulations to limit the import of leaded paints, leaded raw materials for paints, toys painted with leaded paints and other items that may contain leaded paints available for children.
- Establish forums where paint manufacturers can get assistance for phasing out the use of leaded materials in their paint production.
- Conduct awareness raising activities among raw material suppliers and paint manufacturers, in order to encourage increased availability and use of lead free raw materials
- Paint can labels should be required to alert users to the hazards of lead-contaminated dust and other materials when previously painted surfaces are scraped or sanded in preparation for repainting.

At the consumers level

- Always ask for un-leaded paint to protect the health of the children as well as all the members of the family. Large consumers that use purchase orders can specify unleaded paints meeting the Sri Lankan regulation.

At scientific, environmental and health associations' level

- Raise public awareness on health hazards of lead
- Encourage health agencies and health care providers to make available testing of lead levels in blood and its remedy.

Recommendations to paint manufacturers, vendors, large purchasers, etc.

- Switch to safer non-lead alternatives for paint ingredients. These substitute materials are available in the market at an affordable price.
- Clean the production line with un-leaded raw materials and prevent using lead soldered paint cans.

Appendix I

Table 6: Sample details on color and the lead concentration

Sample ID	*Lead concentration (ppm)*	*Colour*	*Date manufactured*	*Date of purchase*	*Label indicating low lead content*
SRL 131	< 6	Yellow	Aug-12	5.12.12	Yes
SRL 183	< 8	Brown	28.03.2012	10.01.2013	Yes
SRL 102	< 9	White	02.07.2012	10.01.2013	
SRL 162	< 9	White	-	11.01.2013	
SRL 184	< 9	White	18.07.2012	13.11.2012	
SRL 126	11	White	-	11.01.2013	
SRL 163	15	Red	-	15.02.2013	
SRL 149	17	White	20.03.2012	18.10.2012	
SRL 151	18	White	-	13.11.2012	
SRL 176	18	Red	-	10.01.2013	
SRL 119	19	White	14.09.2012	12.01.2013	
SRL 193	20	White	30.06.2012	15.02.2013	
SRL 109	23	Red	1.02.2012	10.01.2013	
SRL 101	24	White	05.06.2012	11.01.2013	
SRL 114	27	White	16.09.2012	19.12.2012	
SRL 138	29	White	-	10.01.2013	
SRL 164	<30	Red	-	17.10.2012	
SRL 115	38	Red	22.11.2012	9.02.2013	
SRL 161	39	Yellow	20.09.2010	13.11.2012	
SRL 172	39	White	30.10.2012	10.01.2013	
SRL 186	39	White	27.09.2012	10.01.2013	
SRL 125	45	Red	-	11.01.2013	
SRL 160	45	White	27.10.2011	13.11.2012	
SRL 143	48	Red	Dec-12	12.01.2013	
SRL 201	53	Red	Aug-12	28.09.12	Yes
SRL 187	55	Red	27.10.2012	10.01.2013	
SRL 134	57	Silver	Oct-12	10.01.2013	
SRL 145	59	Yellow	-	11.01.2013	Yes
SRL 146	59	White	13.01.2012	3.1.2013	Yes
SRL 188	64	White	26.11.2011	10.01.2013	Yes
SRL 153	67	White	11.09.2012	10.01.2013	
SRL 189	67	Yellow	10.07.2012	10.07.2012	Yes
SRL 200	67	Brown	Not clear	12.01.2013	Yes
SRL 144	69	White	-	18.10.2012	Yes
SRL 198	85	Red	29.02.2012	10.01.2013	
SRL 104	91	White	-	11.01.2013	
SRL 157	100	Red	31.03.2012	10.01.2013	Yes

SRL 171	101	Gold	18.08.2011	10.01.2013	
SRL 112	123	Red	26.11.2010	11.01.2013	
SRL 197	148	Red	30.11.2011	10.01.2013	
SRL 181	163	White	-	17.10.2012	
SRL 130	166	White	Jun-12	28.09.2012	Yes
SRL 147	230	Red	07.04.2011	28.09.2012	Yes
SRL 170	260	Red	26.07.2012	12.01.2013	
SRL 135	330	Yellow	May-12	14.09.2012	Yes
SRL 122	460	White	-	15.02.2013	
SRL 136	470	Yellow	-	10.01.2013	
SRL 129	1,220	Red	-	12.1.2013	
SRL 192	1,350	Gray	-	12.01.2013	
SRL 111	1,880	Yellow	-	10.01.2013	
SRL 118	2,700	Offwhite	-	11.01.2013	
SRL 191	2,700	White	-	12.01.2013	
SRL 133	2,900	White	29.03.2012	11.01.2013	
SRL 178	3,000	White	-	15.02.2013	
SRL 159	3,100	Red	-	10.01.2013	
SRL 128	3,400	White	27.03.2012	12.01.2013	
SRL 190	3,400	Pink	Not clear	12.01.2013	
SRL 142	3,500	White	Apr-12	12.01.2013	
SRL 199	3,500	Red	8.10.2012	3.1.2013	
SRL 100	3,700	Red	30.06.2011	10.01.2013	
SRL 137	3,800	Red	-	10.01.2013	
SRL 165	4,000	White	13.02.2012	13.11.2012	
SRL 141	4,700	White	7.2012	3.1.2013	
SRL 116	5,000	Red	-	11.01.2013	
SRL 139	5,000	Red	13.05.2011	10.01.2013	
SRL 110	5,200	White	-	10.01.2013	
SRL 108	5,700	Red	-	11.01.2013	
SRL 167	6,800	Red	24.5.2012	3.1.2013	
SRL 105	7,100	Yellow		10.09.2012	
SRL 158	8,900	Red	-	28.09.2012	
SRL 194	10,000	Black	-	10.01.2013	
SRL 140	10,200	Green	Jul-12	25.10.2012	
SRL 154	10,200	Yellow	-	13.11.2012	
SRL 169	12,800	Yellow	17.02.1012	10.01.2013	
SRL 148	14,700	Green	-	18.10.2012	
SRL 107	15,400	Red	Dec-12	11.01.2013	

SRL 196	18,000	Yellow	03/2011	11.01.2013	
SRL 124	21,000	Green	-	13.11.2012	
SRL 179	21,000	Yellow	-	15.02.2013	
SRL 185	22,000	Yellow	16.05.2012	13.11.2012	
SRL 123	24,000	Yellow	23.12.2011	19.10.2012	
SRL 152	29,000	Yellow	-	13.11.2012	
SRL 127	32,000	Green	-	11.01.2013	
SRL 106	39,000	White	Dec-12	11.01.2013	
SRL 117	48,000	Yellow	-	11.01.2013	
SRL 166	50,000	Yellow	11/6/2012	10.09.2012	
SRL 103	53,000	Green	15.07.2011	28.09.2012	Yes, but manufactured before standard was mandatory
SRL 195	55,000	Yellow	-	11.01.2013	
SRL 121	56,000	Green	-	10.01.2013	
SRL 180	63,000	Yellow	-	17.10.2012	
SRL 120	64,000	Yellow	23.03.2010	10.01.2013	
SRL 177	64,000	Yellow	-	17.10.2012	
SRL 132	129,000	Yellow	25.04.2012	11.01.2013	
SRL 113	131,000	Red	-	28.09.2012	

Appendix II

Table 7: Distribution of Lead Concentration by Brand of New Enamel Decorative Paints Purchased

Brand	*Number of Samples*	*Number of samples below <90 ppm*	*Number of Samples between 90-600 ppm Lead*	*Number of Samples between 600- 10,000 ppm Lead*	*Number of Samples Above 10,000 ppm Lead*	*Minimum ppm*	*Maximum ppm*
B01	1			1			6,800
B02	2	1			1	27	131 000
B03	1			1			2,700
B04	1	1					< 8
B05	1			1			5,000
B06	2	1		1		29	3,800
B07	1			1			3,100
B08	2		1	1		91	7,100
B09	2			1	1	3,400	32,000
B10	2	2				39	55
B11	2			1	1	3,000	21,000
B12	2				2	21,000	24,000
B13	1	1					18
B14	2		1		1	460	56,000
B15	1		1				123
B16	1	1					23
B17	1		1				100
B18	1			1			1,350
B19	1	1					53
B20	2			1	1	2,900	129,000
B21	2	1			1	67	10,200
B22	1	1					20
B23	2		1		1	163	63,000
B24	2	2				59	69
B25	3	1	2			39	260
B26	2	1			1	18	29,000
B27	3	3				<9	15
B28	2	1	1			59	230
B29	3			2	1	2,700	48,000
B30	1			1			3,400
B31	1				1		64,000
B32	1			1			8,900
B33	2	1	1			< 6	166
B34	1			1			1,220

B35	2	1		1		48	3,500
B36	3	1	2			57	470
B37	1	1					38
B38	2			2		1,880	5,200
B39	3	2			1	< 9	53,000
B40	1		1				148
B41	1			1			3,500
B42	2	2				11	45
B43	2	2				64	67
B44	2	2				39	45
B45	1	1					67
B46	1			1			3,700
B47	2			1	1	4,000	50,000
B48	1				1		12,800
B49	1				1		18,000
B50	1				1		10,000
B51	2			1	1	4,700	10,200
B52	1	1					85
B53	2	1			1	< 9	22,000
B54	3			1	2	5,700	39,000
B55	1				1		55,000
B56	2	1			1	17	14,700
B57	2	1			1	19	64,000
Summary	**94**	**35**	**12**	**23**	**24**		

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Published by

Centre for Environmental Justice
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