



2018 Unaccounted Used Oil Study

Victoria, British Columbia

Prepared for:
British Columbia Used Oil
Management Association
(BCUOMA)

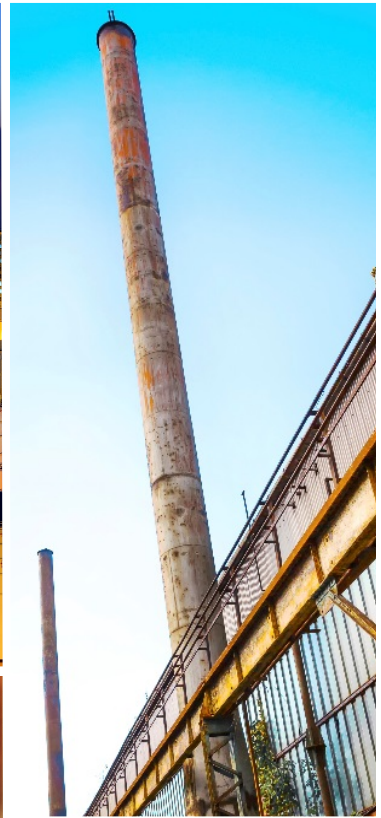




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Appendix A List of Contacts that Provided Information for this Study

Appendix B Collection by Regional District Summary

List of Conversions, Symbols and Acronyms

ANFO	Ammonium Nitrate Fuel Oil
BC	British Columbia
BCUOMA	British Columbia Used Oil Management Association
BTU	British thermal unit
CIU	Consumed-in-Use
Collector	Registered Collector
DIY	Do-It-Yourself
Generator	used oil materials generator
GDP	Gross Domestic Product
GHD	GHD Limited
HDPE	High-density polyethylene
HW	Hazardous Waste
HHW	Household Hazardous Waste
L	litres
Processor	Registered Processing Facility
RD	Regional District
Return Facility	Registered Return Collection Facility
Study	2018 Unaccounted Used Oil Study



1. Introduction

GHD has prepared this study (Study) to estimate the different uses or disposal methods of used oil that was not collected and processed through the British Columbia Used Oil Management Association (BCUOMA's) oil collection and management program in 2018 (thereby, considered unaccounted). As part of this Study, GHD quantified the unaccounted oil sources and developed a report summarizing the review and study findings.

BCUOMA is a not-for-profit society formed under the British Columbia Society Act in 2003. BCUOMA's role is to ensure the responsible management of oil, filters, antifreeze, and containers sold, distributed, or imported for commercial use by its members. Used oil collected through the program is re-refined into new lubricating oil or processed for use as fuel in pulp mills, cement plants, and asphalt plants.

1.1 Background and Scope of Study

BCUOMA is composed of 255 (2018) producer members in British Columbia (BC), and is responsible for the operation of a province-wide collection and management program for used lubricating oil, oil filters and used oil containers sold through the producer members' retail and wholesale facilities.

The BCUOMA recycling program consists of a network of over 4,000 used oil material generators (Generators), of which almost 291 of them are Return Collection Facilities (Return Facilities) for the do-it-yourselfers (DIYs) in 2018. The Generators consist mainly of auto service and repair centers and industrial operations throughout BC. BCUOMA Registered Collectors (Collectors) regularly pick up the used oil materials from the Generators and deliver them to BCUOMA Registered Processing Facilities (Processors) in BC, Alberta (AB), and Washington State (WA).

This Study included the analysis and quantification of unaccounted used oil in 2018 based on oil sales in the province and from the operation of BCUOMA's collection and recycling program. Provincial oil data for 2018 has become available. BCUOMA initially estimated the 2018 unaccounted portion to be **21.93 million litres (L)** and has been subdivided into major categories for further analysis and quantification. A similar study was completed for BCUOMA's 2005 calendar year (Spence, 2006), and 2013 (Conestoga-Rovers & Associates, 2013), which has been used as a resource for this 2018 Study. An additional study (Review of the Recovery Rate for Used Oil in Quebec completed in Quebec) completed in 2010 (Recyc-Quebec – SOGHU, 2010 Ni Environnement/Dessau) to determine a rate for used oil recovery in Quebec has also been reviewed.

For the purpose of this Study, it was assumed that the carryover of unaccounted used oil from year- to-year is equal or very close to equal, therefore, the potential long-term storage of unaccounted used oil was not considered. Quantifying the sub categories of unaccounted used oil is a challenging practice because of the variety of sources, categories and uses associated with it. A list of contacts was developed (and reviewed by BCUOMA) including companies and individuals associated with all aspects of oil production, use, collection, and recycling and various industries that



use lubricating oil in order to determine and quantify the potential uses/disposal methods of the unaccounted oil.

According to the 2018 BCUOMA Annual Report, 50.56 million L of used oil collected through the BCUOMA program is re-used (69% - 34.89 million L) or recycled (31% - 15.67 million L). Used oil recycled for re-refining purposes yields new consumer lubricating oil products that are shipped to retailers across the province. The remaining quantity of used oil that is collected is distributed to pulp mills (1.00 million L), asphalt plants (greater than 7.50 million L), and other approved end uses (2.29 million L). (BCUOMA, 2018).

For oil filters, the process yields crushed paper and metal, and reclaimed oil. For oil containers, processing yields HDPE pellets and reclaimed oil. The recovered oil from the collected oil filters and containers is included in the total oil collected.

1.2 Organization of the Report

This Report has been organized into the following sections:

- **Section 1.0 Introduction:** presents an introduction and background to the Study.
- **Section 2.0 Methodology:** conveys how the Study was performed and provides list of contacts.
- **Section 3.0 Data Collection, Results, and Discussion:** presents the data collected for the Study provided by BCUOMA, Generators, Collectors, Return Facilities, Processors, and additional resources along with the results and discussion for each category.
- **Section 4.0 Used Oil Recycling and Collection Industry Challenges:** discusses challenges facing the used oil collection industry in 2018 that affected the results of this Study.
- **Section 5.0 Opportunities to Increase Used Oil Recycling:** proposes measures to increase the amount of used oil collected through the BCUOMA program and used oil recycling in the province.
- **Section 6.0 Conclusions:** provides a summary of the performed Study and concluding statements.

1.3 Review of Existing Studies

This Study included reviewing the following studies and reports to quantify by source the unaccounted used oil in British Columbia for 2018:

- A review of the 2011 Unaccounted Used Oil Study (CRA, 2013), 2006 Unaccounted Used Oil Study, and the 2005 Consumed-in-Use (CIU) Study
- Conestoga-Rovers & Associates. (CRA, 2007). Used Oil Filter Study
- 2010 Review of the Recovery Rate for Used Oil in Quebec (Recyc-Quebec – SOGHU, 2010 Ni Environnement/Dessau)
- 2017 BCUOMA Annual Report
- 2018 BCUOMA Annual Report
- 2018 BCUOMA Used Oil Filter Study



- 2018 Waste Characterization Studies at Refuse Disposal Facilities (Golden, Revelstoke, Salmon Arm, and Sicamous – Columbia Shuswap Regional District)
- TRI Environmental Consulting Inc., Solid Waste Characterization Study – Regional District of Fraser-Fort George, 2018
- TRI Environmental Consulting Inc., Solid Waste Characterization Study – Columbia Shuswap Regional District – Golden Refuse Disposal Site, 2013
- TRI Environmental Consulting Inc., Solid Waste Characterization Study – Columbia Shuswap Regional District – Salmon Arm Refuse Disposal Site, 2013
- TRI Environmental Consulting Inc., Waste Composition Monitoring Program – Metro Vancouver, 2018
- Maura Walker and Associates Environmental Consultants, Solid Waste Characterization Study, Regional District of Nanaimo, 2013

2. Methodology

For the purposes of this Study – market segmentation, the opinion of professionals and vendors, review of applicable media report, and analysis of provincial, national and industry Gross Domestic Product (GDP) was used in conjunction with analysis of provincial population trends from 2008 to 2018 to extrapolate unaccounted used oil quantities. A target recovery rate has not been established by BCUOMA.

Based on discussions with BCUOMA and a review of existing reports and literature, additional sources of unaccounted used oil were considered for this Study versus the previous studies, notably the rail and mining industries and virgin oil contained in new vehicles as well as used oil contained in End-of-Life vehicles. It is likely that some motor oils are sold in BC and are used in other provinces (and conversely sold in other provinces and disposed of in BC), however, these quantities are assumed to be small and were not considered as part of this Study.

For the purposes of this Study, GHD has reviewed and compared various economic and population metrics including provincial and national GDP, the contribution to provincial GDP from various industries, and changes in provincial population from 2011 to 2018 as outlined in the table below. This was performed to determine potential quantities of unaccounted for used oil associated with each category. The basis of comparison used (GDP vs population) was selected depending on applicability to that particular industry/unaccounted for used oil end use category. GDP serves as a metric of provincial and national economic output and economic growth and was deemed to be a useful metric for determining unaccounted used oil in several categories as part of this Study (pulp mills and logging, construction, cement, transformer and insulating oils, mining, the naval and marine industry, and the rail industry). Population growth also serves as a key metric of growth and prosperity and was deemed to be applicable to determining unaccounted used oil from use in used oil burners and miscellaneous unaccounted for used oil disposal activities.



Table 2.1 BCUOMA Program Summary

Year	Virgin Oil Sales (million L)	Used Oil Recovered (million L)	Used Oil Not Recovered (million L)	BC GDP (\$ '000s)	BC Population ('000s)
2009	N/A	N/A	N/A	\$189,058,000	4,410,506
2010	85.1	47.5	37.6	\$194,131,000	4,466,000
2011	93.5	48.0	45.5	\$199,646,000	4,400,000
2012	88.7	49.4	39.3	\$204,805,000	4,566,769
2013	95.8	50.0	45.8	\$209,623,000	4,630,000
2014	93.0	48.1	44.9	\$217,076,000	4,707,103
2015	97.7	47.3	52.4	\$222,121,000	4,776,388
2016	92.6	46.4	46.2	\$229,575,000	4,859,250
2017	99.7	47.8	51.9	\$238,790,000	4,992,000
2018	97.3	50.64	46.7	\$246,260,000	4,991,687

As presented in the above table, the quantity of used oil that was not recovered and recycled under the BCUOMA program has increased from 45.5 million L in 2011 to 46.7 million L in 2018 (a 2.6% increase). Furthermore, the amount of virgin oil sales in BC increased from 93.5 million L in 2011 to 97.3 million L in 2018 (a 4.1% increase). The amount of used oil collected under the BCUOMA program has remained relatively stable (48.05 million L to 50.646 million L) from 2011 to 2018. The GDP of BC increased from \$199.646 billion to \$246.260 billion (a 23% increase). Additionally, the population of BC increased from 4,400,000 to 5,001,000 (a 14% increase). Therefore, both the GDP and population have increased significantly from 2011 to 2018, yet the amount of used oil collected under the BCUOMA program has remained relatively stable (with a marked increase noted in 2018 to 50.64 million L). Therefore, oil sales are somewhat correlated with an increase in GDP and population, however, overall the amount of used oil collected under the BCUOMA program (and unaccounted for used oil) is not.

The 2018 BCUOMA Annual Report indicates that 97.3 million L of virgin oil were sold in BC, and 50.64 million L of used oil were recovered through the BCUOMA collection and recycling program in the 2018 calendar year. After subtracting the CIU portion of the sales and the recovered used oil, there remains an unaccounted portion of used oil (estimated by BCUOMA at 17.45 million L). BCUOMA is aware of the major uses/disposal methods of unaccounted used oil; however the quantities associated with each are unknown and vary over time. The objective of this Study is to estimate the quantities associated with the major uses/disposal methods and estimate the amount of oil for each unaccounted for category to account for the 17.45 million L of unaccounted used oil (BCUOMA estimate). The CIU source of error results in a range of unaccounted used oil from 11.59 to 23.31 million L which encompasses the variability in oil sales each year and the uncertainty associated with the CIU value and unaccounted quantities.

An assumption that 30.1 percent of oil sold is CIU and cannot be collected has been used based on a previous CIU study for BC prepared for BCUOMA by Rob Spence (Consultant) (Spence, 2005). A ±20 percent source of error (24.1 to 36.1 percent) has been applied to the CIU factor in order to account for the variation of the CIU factors for each use and type of oil. Industry specific CIU ratios can range from 4 to 80 percent as outlined in the table below (Spence, 2005), resulting in a range for



the unaccounted used oil portion. It is anticipated that the average CIU ratio will decrease over time due to increases in engine efficiency.

Table 2.2 % CIU by Product

Product Type	% CIU by Product
Passenger Car Motor Oil	8.0
Heavy Duty Engine Oil	38.4
Hydraulic Fluid	27.5
Tractor Hydraulic Fluid	20.0
Automatic Transmission Fluid	4.0
Railroad Engine Oil	62.5
Natural Gas Engine Oil	80.0
Marine Engine Oil	60.0
All Other	15.5

In preparation for this Study, the Recyc-Quebec – SOGHU, 2010 Ni Environnement/Dessau study was reviewed. The Recyc-Quebec study provided information and detail into theoretical recovery rates for various industries. It is important to note that the province of Quebec has an extensive automotive manufacturing industry and much less marine activity than BC. In addition, the Recyc-Quebec study reported that 39.1% was CIU for passenger car motor oil versus vs 25.8% in British Columbia. The Recyc-Quebec, 2010 study used statistical modelling and economics to determine a theoretical maximum recovery rate for used oil in Quebec. This Study used data and adopted similar methodologies from the Recyc-Quebec, 2010 report and applied this data to the used oil recycling industry in British Columbia in 2018.

Based on information and discussions with BCUOMA, virgin motor oils associated with new vehicles, machinery, and products are included in the reported virgin oil quantity of 99.70 million L. In addition, it is assumed that the majority of used oils associated with End-of-Life vehicles would be collected at approved facilities and ultimately be included in the BCUOMA program.

After the initial meeting with BCUOMA, a contact list was developed that included companies and individuals involved in the used oil recycling and recovery industries. Over 300 individuals and companies were contacted and a total of 47 representatives provided information relevant to this study. These contacts ranged from the oil producers themselves through to the consumers and finally the collectors and recyclers. The contacts were subdivided into major categories to ensure end uses/disposal methods were considered and identified so that the received information could be quantified, compared, and accurately reported. Conversations and emails with each contact were logged and summarized in a communication log, which has been provided to BCUOMA under separate cover. Unaccounted for used oil has been divided into the following major categories:

- Used Oil Burner
 - Paving companies
 - Used Oil Furnaces, Boilers, and Air Conditioners
- Pulp and Paper Mill
- Mining



- Landfills
 - Oil Filters and Containers
 - DIY Other
- Cement
- Explosives Manufacturing
- Rail
- Engine Oil Burn Systems
- Naval Vessels
- Miscellaneous Unaccounted For Used Oil

A list of contacts that provided information for this Study is included as Appendix A.

3. Data Collection, Results, and Discussion

A summary of the quantified unaccounted used oil in BC for each investigated category is presented in Table 1.

The initially estimated total quantified amount of unaccounted used oil calculated in the Study is 17.45 million L (provided by BCUOMA using an assumed CIU rate of 30.1%). This estimated amount corresponds with the BCUOMA reported oil sales and the recovered oil quantities as well as the CIU quantity. The 20 percent source of error on the CIU factor has an impact on all categories and estimate and, therefore, the specific CIU factor for the oil type and end use has been applied, where possible to improve estimates in each category. The current CIU range is from 11.59 million L to 23.31 million L of unaccounted oil based on plus/minus 20% CIU. The results of this Study indicate that approximately 22.82 million L can be considered as unaccounted used oil in 2018. Note that based on the results of this Study that the calculated unaccounted for used oil quantity (22.82 million L) is within this potential range assuming a plus/minus 20% CIU range of 11.59 to 23.31 million L.

Where the consumption of used oil is associated with a specific practice or process as in explosives' manufacturing and large diesel power engines the quantifiable amount of used oil consumed can be estimated (included and based on the CRA, 2013 study). Many of the other categories of investigation require estimates based on conversations, historical data, comparison to metrics such as GDP and population as mentioned in Section 2.0.

The results for each category of investigation are presented below with a further explanation of estimation methods and practices relating to each specific category.

BCUOMA provided a copy of the Collection by Regional District (RD) summary for the years 2015 to 2018 as part of this study to report used oil collection and recycling per Regional District (a summary of this data is included as Appendix B). Use per capita is provided in the 2018 Annual Report, which shows that the highest rates of used oil recovery per capita were in the northeast areas of the province (Northern Rockies and Peace River). The Stikine District also reported a high rate of used



oil recovery. The lowest rates of used oil recovery per capita were in the major cities (Metro Vancouver, the Capital Region, and Nanaimo).

The above data for L of used oil recovered per person shows that the highest rates of used oil recovery per person is typically associated with the northeast areas of the province, and the lowest rates of used oil recovery per person are associated with the major cities in BC. Note that the rate of used oil recovery per person for common geographic areas of the province and major population centres is generally consistent among similar geographic areas (based on latitude, rural vs urban areas, and similar levels of industrial activity). The average rate of used oil recovery per person for the province of BC is 10.11 L per person. Higher rates of recovered used oil in the northern, rural areas of the province are believed to be related to the higher quantity of virgin oil sold in these rural areas and increased industrial activity (forestry, farming, fishing, and mining) per person in these areas. Furthermore, increased use of small automobiles, mass transit, and electric vehicles in urban areas and less distance travelled per trip also likely contribute to a lower rate of used oil recovery in urban areas. The quantities of virgin oil sold per district is not available for this Study.

Div.	Name	2018 Used Oil Recovered (L)
1	Alberni-Clayoquot	415,988
2	Bulkley-Nechako	463,981
3	Capital	2,740,235
4	Cariboo	985,606
5	Central Coast	32,067
6	Central Kootenay	1,465,564
7	Central Okanagan	2,463,491
8	Columbia-Shuswap	794,051
9	Comox Valley	895,210
10	Cowichan Valley	599,078
11	East Kootenay	1,496,807
12	Fraser Valley	2,495,866
13	Fraser-Fort George	1,675,233
14	Metro Vancouver	20,758,942
15	Kitimat-Stikine	545,784
16	Kootenay Boundary	775,228
17	Mount Waddington	145,091
18	Nanaimo	1,264,470
19	North Okanagan	1,058,495
20	Northern Rockies	1,002,979
21	Okanagan-Similkameen	1,044,423
22	Peace River	3,740,236
23	Powell River	195,404
24	North Coast	187,012
25	Squamish-Lillooet	535,428
26	Stikine Region	130,184
27	Strathcona	602,275



Div.	Name	2018 Used Oil Recovered (L)
28	Sunshine Coast	377,181
29	Thompson-Nicola	1,678,473

3.1 Repurposed by Owner

3.1.1 Paving Industry

The paving industry uses used oil for the purposes of heating asphalt and for the production of asphalt. Formula Powell (FP) is a used oil collection company that is not registered through the BCUOMA program and services the northern parts of BC. FP formerly supplied a number of the northern paving companies with unaccounted used oil for the paving industry but reported that very little to no used oil was used by the paving industry in 2018. This practice has been confirmed previously by FP. Road oiling is likely not to take place as commonly as in the past as it is no longer legal in BC, however, it is possible that this still occurs to some extent in the northern part of the province. Several large collectors reported sending used oil to the paving industry during the summer (some interviewees indicated that much or all of their collected used oil goes to the paving industry in the summer months) through the BCUOMA program and is documented. Paving industries are consumers of the majority of the used oil that is self-generated and even purchase contaminated oil from used oil processors for heating asphalt (through the BCUOMA program).

A previous estimate of **1.44 million L** of unaccounted used oil for 2011 (included in the Used Oil Burners category in the 2013 study) was attributed to the paving industry and road oiling. However, road oiling is assumed to be zero in 2018 due to regulations on road oiling for dust prevention and sale of contaminated oil to re-processors along with increased collection locations and focus on proper disposal and recycling practices. It is assumed that the majority of used oil sent to the paving industry is accounted for through the BCUOMA program. Therefore, zero (**0 L**) unaccounted used oil is attributed to the paving industry in 2018.

3.1.2 Used Oil Burners, Boilers and Air Conditioners

When used oil is burned in furnaces, boilers or air conditioners, it is typically generated on-site. Companies and individuals, who burn used oil in this manner, are also typically located in the northern areas of the province and Kootenay, where the recycling of used oil is not as feasible or convenient as other remote areas of the province.

BCUOMA provided a copy of the Collection by Regional District summary for the years 2015 to 2018 as part of this study to report used oil collection and recycling per Regional District (a summary of this data is included as Appendix B). This information presented used oil recovery trends from 2015 to 2018 per Regional District (separating data from rural districts vs urban districts). A reportable decrease in collection was not identified up to 2017, however, notable decreases were reported for several rural districts in 2018. This should be monitored as it may indicate increased levels of burning in furnaces and boilers in rural areas of the province.

Several British Columbia Ministry of the Environment (MOE) offices were contacted as part of this Study. Respondents indicated that they were generally aware of burning of used oil in furnaces in garages and car dealerships in rural areas, but had no quantifiable data to provide.



Through contact with the used oil furnace, boiler, and air conditioner retailers it was determined that the industrial, commercial, and residential markets for the purchase of these types of units have remained generally stable or have decreased since 2011. Higher sales were identified by some retailers in the northern parts of the province. One of the retailers, Clean Burn, identified their most common unit size is 250,000 BTU which consumes up to 6.4 L of used oil per hour and typically operates for 1,400 hours per season. Clean Burn sells furnaces and boilers ranging from 140,000 to 500,000 BTU. Typical customers for these units are small garages, car dealerships, and some municipal maintenance depots in the rural and northern areas of the province. Very little to no used oil burning is reported to occur in the Capital or Lower Mainland regions.

Ratios of the number of units to the population were used as part of the 2013 CRA study to estimate the number of units currently in use in the province. These ratios have been utilized for the purposes of this Study. The northern rural regions of the province were assigned a unit to population ratio of one unit per 1,000 people (1:1000) whereas the more southern rural regions were assigned a ratio of 1:3,000; ratios were based on the 2005 study since markets have remained generally stable since then (Spence, 2006). The densely populated areas (Metro Vancouver, Fraser Valley, Nanaimo, and Capital) were assigned a more conservative ratio of 1:25,500 in the 2005 study and in this 2018 Study, as this type of heating is not likely to be as common in these areas as there is greater opportunity for used oil collection and more environmentally friendly heating methods available. The areas discussed above are presented in the figure below. All the unit sizes (BTUs) and consumption rates from the retailers were analyzed to determine the total number of units and the amount of used oil consumed per year by size. With the information provided from retailers and current census population data ratios, the number of units was estimated to be in use in BC in 2011 was 922 and 794 used oil burners in 2018 which is generally consistent. Based on the interviews, it is not likely that additional units are being operated since approximately 2014 due to increases in unit price associated with tariffs and currency exchange rates. However, based on discussions with local representatives in rural and northern areas of the province their use and the use of unaccounted used oil in them has increased.

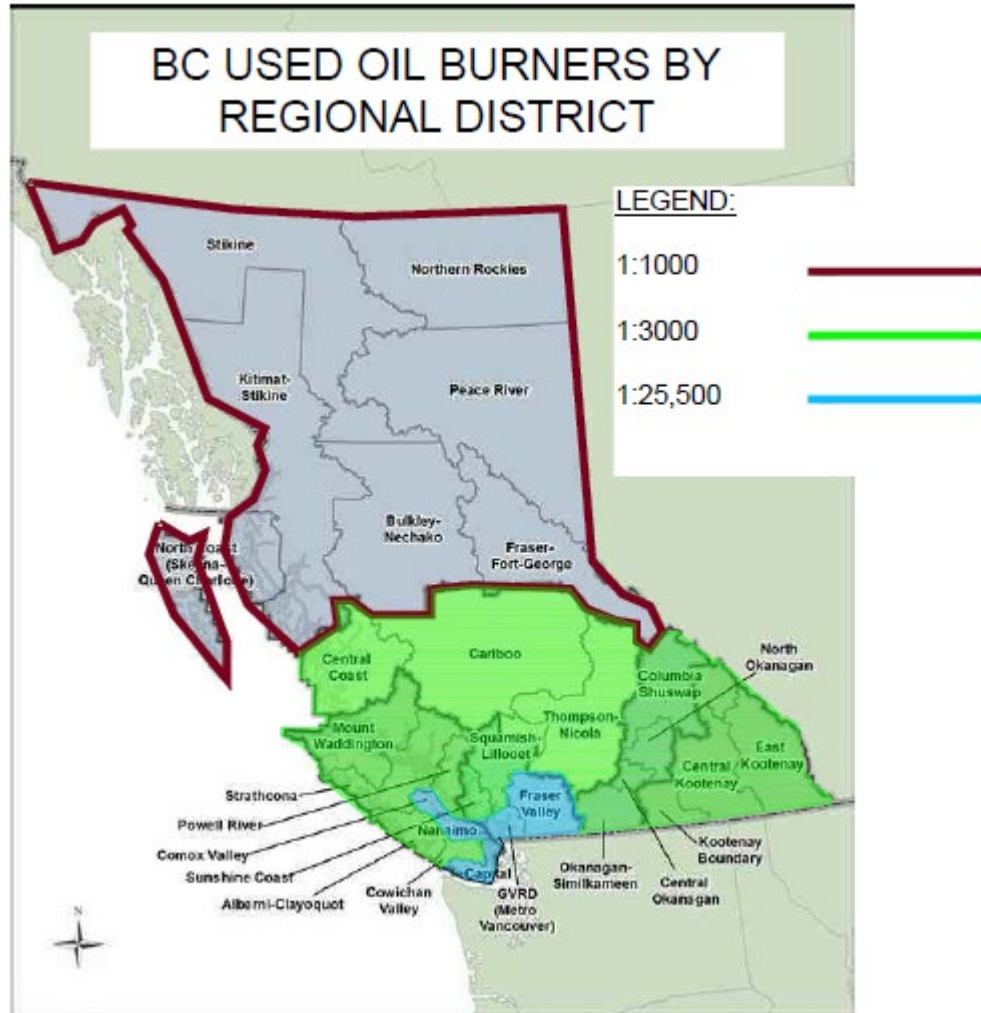


Figure 3.1 BC Used Oil Burners by Regional District

Assuming that approximately 665 used oil burners are operated in rural, northern areas of the province (excluding major urban areas) at full capacity (1,400 operating hours), and that each used oil burner consumes 6.4 L of used oil per hour (average burner size - 250,000 BTU) over 1,400 operating hours per season, it is estimated that approximately 5.96 million L of used oil are burned in used oil burners from approximately October to March in remote and northern areas of the province each year. The number of operating hours per season and the used oil consumption for the southern rural areas of the province and the Lower Mainland is not known, however, is assumed to be much lower than the northern rural areas of the province. Therefore, the operating hours and resulting quantity of used oil consumed in used oil burners in the southern, more rural areas and the Lower Mainland is less than 5.96 million L even with a higher population due to better access to used oil recycling programs and a warmer climate. The above calculations have been performed for comparison purposes to the final calculated unaccounted used oil quantity (below) associated with used oil burners in the province as a check for consistency.

The quantity of total recovered used oil has slightly increased from 47.88 million L in 2011 to 50.64 million L in 2018, a percentage change of 5.76%, despite a population change for the



Province of British Columbia from 2011 to 2018 of over 14%. Note that the population in Fort St. John, BC, increased by approximately 7.1% from 2011 (18,572) to 2016 (19,897) and the population of Prince George increased by approximately 4.6% from 2011 (62,623) to 2016 (65,510). The population trends in these cities were reviewed because they are likely indicative of population trends in rural areas of the province, where used oil burners are more prevalent. Therefore, a provincial increase in recovered used oil was not observed despite an increase in provincial and rural population. It has been assumed in this report that typically anticipated increased quantities of unaccounted used oil that would likely be associated with this population change are being offset and burned in furnaces in remote and northern parts of the province. This has been confirmed through discussions with local representatives in these areas, collectors, and dealers. Based on this, an additional 45% (beyond the 2011 to 2018 population increase) of unaccounted used oil has been attributed to this category since 2011. This 45% additional increase was chosen as an estimate of increased used oil burning in furnaces in this Study based on anecdotal evidence gathered interviewing various representatives in rural and northern areas of the province. Therefore, the total quantity of used oil estimated to be consumed by used oil burners in 2018 is **10.01 million L**. As noted above – approximately 5.96 million L is assumed to be consumed in used oil burners in colder northern, rural areas of the province which is consistent with the final calculated quantity of used oil consumed in burners in the entire province of 10.01 million L.

3.1.3 Engine Oil Burn Systems

Large power engines (greater than 2,500 HP) typically within large ore haul trucks in mining sites around the province have engine oil burn systems. In addition, some remote power plants use used oil burn systems to remove the need to manage their used oil generate on site. These engine oil burn systems allow for extended oil draining intervals which reduces downtime for the trucks and engines. These engine oil burn systems have been banned in the U.S. in diesel vehicles unless they have been certified against the emissions standards. The estimate from the previous study (Spence, 2006) and CRA, 2013 of 600,000 L has been assumed to remain unchanged for 2018. This practice still takes place in the mines in BC and likely in other parts of the province where extended service intervals and used oil generation reduction is desired, as these types of systems can be retrofitted to diesel engines; including diesel trucks and stationary power generators. For this 2018 study, no additional information is available since the previous 2013 study and it is estimated that **0.60 million L** of used oil is consumed by engine oil burn systems.

3.1.4 Pulp, Mill, Logging, and Construction – Used Oil Lubricants

Three pulp, mill, and logging companies provided information related to used oil management and recycling for this Study (Canada Forest Products – now Canfor Taylor Pulp, Catalyst Paper Corporation and Domtar Inc.). Canfor Taylor Pulp stated that they typically purchase 20,000 L of lubricating oil per year. Catalyst Paper Corporation stated that they purchased 140,000 L of lubricating oil annually and recycle 48,900 L (very approximately). This is somewhat consistent with the Recyc-Quebec – SOGHU, 2010 Ni Environnement/Dessau report that indicated that 44.3% of oil in the pulp and paper industry is potentially recyclable. Another company (Domtar Inc.) stated that they purchase 59,771 L annually and recycled 57,224 L annually which is a very high recycling rate confirming a low CIU rate. Therefore it is likely that there is a wide range in recycling rates in the forestry industry in British Columbia. All of the interviewees stated that they do not use used motor



oil for kiln drying or heating – kiln drying and heating is provided by natural gas or fuel oil and that all of their used oil is collected by approved BCUOMA collectors for recycling.

From the CIU Study completed by Rob Spence in 2005, it was estimated that 50 percent of the hydraulic oil and 25 percent of the heavy duty engine oil sales were attributed to plywood mills, pulp and paper mills, logging, and construction companies. This quantity was assumed to be representative of the 2018 year as well. After the CIU factor was applied to the 2011 sales for these two types of oil, 9.35 million L of used oil is potentially available for recycling. Using the same assumptions as in the 2005 and 2011 studies, 50 percent of used heavy duty engine oil and 75 percent of used hydraulic oil is used for a variety of lubrication purposes in each of the industries (Spence, 2006), which is estimated at 6.10 million L for 2018, compared to 3.1 million L for 2005.

It is noted that this may be an over-estimate based on reported increased collection practices and interviews with industry conducted as part of this Study. However there is currently no accurate way to determine unaccounted used oil quantities based on the interviews and estimate this difference in practice. The GDP for forestry industry (logging) in BC has increased from \$1.81 billion in 2011 to \$1.91 billion in 2018. However there is no data to indicate that this increase in GDP in this sector would equate to an increase in unaccounted used oil in this industry.

The GDP of the construction industry was approximately \$14.99 billion in 2011 and \$21.1 billion in 2018. The amount of unaccounted used oil related to the construction industry was not determined for 2018, although is likely to be included in the BCUOMA program. Therefore zero unaccounted used oil is attributed to the construction industry because used oil would likely be collected by BCUOMA registered collectors (particularly in the urban areas). Construction companies were not contacted as part of this Study.

The total estimated unaccountable used oil for this category is unchanged from 2011 and is **6.30 million L**.

3.1.5 Cement Companies and Lime Kilns

Two companies (Cal Portland and Lafarge) agreed to participate in the survey. However, they stated that they (and other companies they are familiar with) recycle their used oil through GFL, Revolution Environmental Solutions, or other registered BCUOMA collectors. Cal Portland used their purchased oil for similar purposes; in vehicles, equipment, gearboxes, forms, and production.

There are many potential sources of unaccounted used oil; re-use for lubrication, contamination, and use for heating in the cement industry. It is estimated that not all recoverable oil is recycled by every company in the industry due to historical practices, collection convenience, and economic feasibility (use of used oil versus purchasing new oil), however, based on interviews conducted as part of this Study the quantity of unaccounted used oil is likely minor. Cement companies contacted as part of this Study stated that they do not burn used oil in on-site lime kilns for cement production. Based on the recycling practices of the companies contacted in this industry during this Study and the 2013 study, as compared to the results of the 2005 study where the majority facilities with lime kilns burned used oil, there has likely been a significant reduction in the amount of used oil that is consumed compared to the previous estimate of 600,000 L (Spence, 2006). Based on contact with Cal Portland, no used oil is combusted in their lime kiln (their kiln uses natural gas). Lafarge also indicated that they do not burn used oil in their cement kilns.



The GDP of the construction industry BC has been used to estimate the increase in economic output and resulting potential used oil usage in the cement industry as compared to the 2013 study.

Although the GDP for the construction industry in the province of BC has increased from approximately \$16.7 billion in 2013 to \$21.1 billion in 2018 the estimated used oil in this category of zero (**0 L** - a reduction from 0.48 million L in 2011) as it is not likely that unaccounted used oil is being burned in lime kilns or the cement industry due to increased awareness and better oil management practices.

3.1.6 Mining Industry and Explosives Manufacturing

The mining industry was not included in the 2013 study, however the mining industry was contacted as part of this Study. Only Teck Highland Valley Copper Partnership and Teck Coal Limited (Coal Mountain Operations) responded who indicated that lubricating oils in trucks and equipment and all recoverable used oil is collected by BCUOMA member collectors. Based on Recyc-Quebec – SOGHU, 2010 Ni Environnement/Dessau, Quebec and British Columbia had similar levels of mining activity in 2006 (\$2.28 billion for Quebec and \$2.26 billion for British Columbia). Furthermore, Recyc-Quebec – SOGHU, 2010 Ni Environnement/Dessau indicated that the mining industry in Quebec had 3.18 million L of recoverable oil in 2010 and a 55% recoverable used oil rate. Based on the above data – it is estimated that **1.43 million L** of unaccounted used oil is potentially attributed to the mining industry in BC in 2010. Therefore, **1.43 million L** is assumed unaccounted for by the mining industry in BC in 2018.

Few contacts were successful within the explosives industry and the contacts able to provide information do not manufacture explosives themselves, but rather purchase them for use. Pashco Blasting Ltd. and Teck Valley Coal (Coal Mountain Operations) provided information related to the explosives industry. The mining and explosives industries in BC are related (use of explosives is largely dependent on the level of mining activity). The contacts that provided information stated that they use very little oil and that BCUOMA member collectors collect the oil they do produce. Previously the coal mines located in the Elk Valley region were producers of explosives. Assuming the Elk Valley mines are still purchasing 5.0 million L of oil each year, the previously estimated values for the use of used oil in the production of explosives are likely to be similar as well. Used oil is used in the production of explosives in some mines (typically site based – up to a 50% replacement for fuel oil in the production of ANFO – Ammonium Nitrate Fuel Oil). Teck Valley Coal (Coal Mountain Operations) was contacted and confirmed that they do not use used oil for the manufacture of explosives onsite. Furthermore, Teck Valley Coal indicated that using used oil for the onsite manufacture of explosives is no longer conducted because the mining companies have little control over quality.

It was identified as part of the 2013 study that one of the largest manufacturers of explosives in BC, Maxam Bulk Services, was diligent about the use and recycling of their oil. Maxam Bulk Services could not be contacted and may no longer be in business (under that name) as part of this study in 2018. There are only four other relatively small explosive manufacturers in BC (Natural Resources Canada, 2012).

Remaining explosive manufacturers in the province are estimated to contribute **0.10 million L** of unaccounted used oil. This low quantity is likely related to expanded recycling practices and the



limited number of explosives manufacturers throughout the province. Therefore, **0.10 million L** is assumed unaccounted for by the explosives industry in 2018 and is unchanged from 2013.

Therefore, **1.53 million L** of used oil is assumed to have been consumed by the combined mining industry and explosives manufacturing industries in 2018.

3.1.7 Haida Gwaii and Very Remote Areas in British Columbia

Some areas of the province (notably Haida Gwaii) are considered very remote and difficult areas to service for the used oil recycling. Haida Gwaii returns zero used oil through the BCUOMA program. Based on discussions with persons and companies interviewed as part of this study, increased burning in used oil furnaces is occurring during the winter months in rural areas and Haida Gwaii. Interviewees in less urban areas of the province made similar comments as part of this Study. Load Em' Up Petroleums located in Prince George recently exited the used oil trucking and recycling industry and stated that illegal dumping does occur and that there is a strong market in rural areas for used oil for burning in furnaces in Prince George during the winter. The representative from Load Em' Up Petroleums also indicated that the price for used oil has dropped from approximately \$0.20 per litre in 2015 to \$0.03 per L by 2018. GFL in Fort St. John collects 3,000 to 5,000 L of used oil from numerous small garages and oil change shops in the summer - however this quantity drops to zero litres in the winter months from October to March (indicative of increased burning of used oil in rural areas – as discussed Section 3.2). Several large used oil collection companies including GFL, Revolution Environmental Solutions stated that the current economics of used oil recycling in rural areas (even larger towns in northern BC) are difficult due to lower crude oil costs, carbon taxes, and high transportation and fuel costs and that the larger companies survive only by providing oil to their own recycling facilities. Larger used oil collection and recycling companies such as GFL, Revolution, and Safety-Kleen typically have their own used oil processing facilities that utilize used oil and produce recycled oil for re-sale back to market. These companies profit on the re-sale of recycled used oil and are better capable of withstanding a challenging used oil collection market.

The quantity of virgin oil sold in Haida Gwaii and remote areas of the province is not available. The Skeena-Queen Charlotte landfill representative was interviewed as part of this study and indicated that all of the used oil currently produced in the Queen Charlotte Islands, Haida Gwaii, and much of the used oil in Prince Rupert, Terrace, and Kitimat is being burned in furnaces and has greatly increased since 2011 and is therefore unaccounted. Further he stated that no oil from Haida Gwaii and the Queen Charlotte Islands is currently being recycled and that several former participants of the BCUOMA program have left the Used Oil Recycling Program.

In the absence of data regarding the amount of unaccounted used oil consumed specifically on Haida Gwaii and other very remote areas of the province, the amount of unaccounted used oil was increased by 45% and was estimated at approximately **0.75 million L**, as it is likely that additional unaccounted used oil is being used for heating vs 2011.

3.1.8 Naval Activity and Marine Industry

GHD contacted BC Ferries, the British Columbia Coast Pilots Association, Silver King Marine Charters, North Arm Transportation, Tymac Launch Services, and Seaspan as part of this study. However GHD was not successful in making contact and obtaining relevant information from these companies.



Based on the 2013 CRA study, most naval companies and vessels have become more diligent with proper disposal of used oil. There are a number of collection locations and companies involved in the collection of used oil which allows for a large portion of used oil from naval vessel to be accounted for. However, when the oil becomes contaminated with water (greater than 35 percent), the used oil processors can no longer claim this oil through the BCUOMA program. The majority of this water contaminated oil comes from the naval vessels and collection points along the coast. In the 2013 BCUOMA study, Silver King Marine Charters identified that naval operators have also become more conscious of the killer whale activity off the shores of BC and as a result there has been a more conscious effort to reduce the number of oil spills at sea.

Previously a total of 400,000 L (Spence, 2006) of unaccounted used oil was estimated through practices such as dumping at sea, burning on-board, and lubrication (fish and pleasure boats, Victoria harbor, BC ferries, cruise ships, coast guard, and navy). It has been assumed that the water-contaminated oil, oil burnt on-board, lubrication, and oil spills at sea account for an estimated 0.40 million L of unaccounted used oil for 2011, with no change from 2005 values.

As part of this Study, the provincial GDP for BC was used as a metric for estimating unaccounted for used oil associated with naval activity and marine industries. These industries are likely associated with provincial economic output and GDP. For the purposes of this study, the GDP for the Province of British Columbia in 2011 (\$199 billion) vs 2018 (\$246 billion) was used to estimate an increase in used oil usage and resulting unaccounted used oil associated with naval activity and marine industries. The increase in GDP (23%) for Canada from 2011 to 2018 was also reviewed to determine an increase in marine and naval activity from 2011 to 2018 and ultimately an estimate of unaccounted used oil in these industries in 2018. The Canadian GDP was reviewed as a possible metric because it is indicative of the BC marine and naval industry servicing the broader Canadian national economy. However, it was deemed that the increase in the GDP of BC was higher than the national GDP increase and therefore provided a more conservative (higher) quantity of unaccounted used oil.

The 2005 CIU study reported a high CIU ratio of 60% for the marine industry. As previously stated in Section 2, an assumption that 30.1 percent of virgin oil sold is CIU and cannot be collected has been used for most categories in this Study based on a previous CIU study for BC. Some CIU oil associated with the marine industry would be considered as unaccounted because the marine industry has a much higher CIU ratio of 60% versus the standard BCUOMA assumption used in this Study of 30.1% (the difference between 60% and the standard assumption of 30.1% is considered as unaccounted). This used oil would not be collected for recycling and would contribute to the quantity of unrecovered used oil to BCUOMA. However, this amount would be difficult to quantify because it is not known how much virgin oil is sold in BC versus offshore for the marine industry and would likely be associated with local smaller vessels.

0.49 million L of unaccounted used oil has been attributed to naval activity and marine industry as part of this Study in 2018.

3.1.9 Transformer and Insulating Oil

Used oil can also be used for purposes other than heating such as insulating and in high voltage transformers, where the oil serves as lubricator and insulator for internal parts. BC Hydro uses all of their used oil for this purpose throughout the province. BC Hydro was contacted as part of this study,



however, did not respond. In 2011, BC Hydro purchased 1.5 million L of virgin oil and with deduction of the CIU factor just over 1 million L of used oil remains. As concluded in 2013, even oil which is contaminated with water is re-used, only a small percentage (less than 1 percent) that is contaminated with PCBs was sent to Terrapure for processing. The GDP associated with utilities in the province (including electricity generation) increased from 2.26% in 2014 to 2.49% of the provincial GDP in 2018 (a 10% increase and generally consistent with the increase in provincial GDP during this period). For the purposes of this study, the GDP for the Province of BC in 2011 (\$199 billion) vs 2018 (\$246 billion) was used to estimate an increase in used oil usage and unaccounted used oil associated with transformer and insulating oil. The amount of virgin oil sold in BC increased 93.5 to 97.3 million L from 2011 to 2018 (a 4.1% increase) – therefore provincial GDP is generally correlated to an increase in virgin oil sold. The provincial GDP for BC was used as a metric for determining unaccounted for used oil associated with transformer and insulating oil because use of transformers and insulating oil is likely associated with economic output and GDP. An increase in GDP and economic output typically results in an increase in the purchase and use of additional transformers and insulating oil associated with new machinery, services and construction activity. Based on this increase in GDP as compared with 2011, after deduction of solid waste and PCB-contaminated oil, it is estimated the total amount of used oil used in transformers and other insulating purposes in 2018 is **1.27 million L** vs 1.03 million L in 2011.

3.1.10 Rail

Unaccounted used oil in the Rail industry was not included in the previous 2013 BCUOMA study, however, is included as part of this Study. Virgin oil sales to the rail industry are either CIU, or recovered and recycled by used oil recycling companies. The methodology used for this category was to compare the British Columbia rail industry vs the Quebec rail industry and make assumptions based on conclusions presented in Recyc-Quebec – SOGHU, 2010 Ni Environnement/Dessau. Based on Recyc-Quebec – SOGHU, 2010 Ni Environnement/Dessau, sales in the Quebec rail industry totaled 2.80 million L in 2008 and British Columbia Oil Sales in the Rail sector totaled 2.76 million L in 2008 which is comparable given the higher population in Quebec and increased port activity in British Columbia. Therefore, in 2008 Quebec and BC had similar levels of rail activity and are comparable for the purposes of this Study. The Recyc-Quebec, 2010 report also indicated that the rail industry has a relatively low 36.7% Recoverable Used Oil Rate (resulting in a high CIU – CIU Ratio of 63.3%). Note that the 2005 CIU study reported a similar CIU ratio of 62.5%. As previously stated in Section 2, an assumption that 30.1 percent of virgin oil sold is CIU and cannot be collected has been used for most categories in this Study based on a previous CIU study for BC. Some CIU oil associated with the rail industry would be considered as unaccounted because the rail industry has a much higher CIU ratio of 63.3% versus the standard BCUOMA assumption used in this Study of 30.1% (the difference between 63.3% and the standard assumption of 30.1% is considered as unaccounted). This used oil would not be collected for recycling and would contribute to the quantity of unrecovered used oil to BCUOMA. Note that the location that rail locomotives are serviced and maintained may not be exclusive to BC and that these activities associated with virgin oil sales and used oil recycling for rail may be performed in other jurisdictions. Also note that virgin oil in locomotives is frequently replenished and that oil changes on locomotives are performed infrequently.

Additionally, the amount of national rail activity was also reviewed to determine the level of rail activity associated with bulk goods from 2011 (314 million tonnes) to 2018 (384 million tonnes) – a



22% increase. This increase in national rail activity was applied to the 2018 BC oil virgin sales quantity for the rail industry and the difference between the standard BCUOMA CIU assumption in this Study and the CIU ratio for the rail industry. Using the above noted methodology, the amount of unaccounted used oil in the rail industry in 2018 was **1.12 million L**.

3.2 Disposal

3.2.1 Landfill

Sixteen landfills were contacted and interviewed as part of this study and offered relevant information as to the status of used oil collection and recycling at landfills. The general consensus was that the majority of districts reported that the volume of used oil dropped off at landfills has increased. The respondents who accept used oil indicated that used oil is being collected by BCUOMA registered collection companies. Many respondents indicated that their landfills receive unlabeled containers of mixed oil, water, antifreeze and misc. oils. However they also stated that they are providing a critical service to the community. The representative from the Kootenay Boundary Landfill indicated that several municipalities in the district are burning used oil in their maintenance garages and other municipal infrastructure. Several municipalities including Nanaimo and North Okanagan indicated that they no longer accept used oil and refer citizens to local drop off depots or the local Canadian Tire (which no longer typically accepts used oil).

Based on the 2013 study, several RDs in BC do not have the services implemented to accept and recycle used oil directly at their landfills. All of the RD landfills contacted redirect customers to local drop-off stations or back to the retailer for proper oil disposal. Annual household hazardous waste (HHW) round-ups are performed by some districts including Columbia Shuswap and North Okanagan, during that time waste is stored on site until picked up by a collector or processor such as Newalta (now Terrapure) or Tervita. In addition, other RDs such as Fraser-Fort George and Thompson-Nicola accept and recycle containers and filters through the BCUOMA program. When the used oil is collected at landfills, there is a high probability of contamination as it is mixed in collection containers/vessels (used oil typically contains small amounts of water and residual contaminants). In 2013 these RDs accepted 22.7 L bag-in-a-box oil bladder bags. This was not documented in this Study.

It is to be noted that rags, motor oils, and absorbents can easily end up in landfills throughout the province inside bagged household garbage without the knowledge of waste management staff. Rural landfill locations in various RDs receive a number of 20 L containers which are not typically contaminated with water and are redirected to BCUOMA. Estimates of landfilled or received waste oils could not be provided by the RDs. Instead, waste audits and characterization studies have been used to estimate the amount of used oil as outlined below.

A 2009 study by Statistics Canada on Household Hazardous Waste (HHW) disposal estimated that approximately 1% of unwanted engine oil or antifreeze was dispersed or dropped off for recovery by homeowners at the local landfill, 61% returned unwanted engine oil and antifreeze to a local depot or drop off centre, 19% returned it to a supplier or retailer, and 0% poured it down the drain or sink.

Tetra Tech conducted a 2018 Waste Characterization Study at the Golden, Revelstoke, Salmon Arm, and Sicamous landfills for the Columbia Shuswap Regional District. The results of this study indicated that HHW constituted 0.9%, 1.5%, 1.6%, and 1.5% of the landfilled waste respectively. The



amount of used oil identified was reported as 0% in this study. It is possible that some leakage of oil had occurred during crushing and disposal and disintegration of containers. It is likely that the amount of unaccounted for used oil disposed of at landfills is decreasing due to increased awareness and access to BCUOMA recycling facilities. This Tetra Tech waste characterization study formed the basis assumptions regarding HHW disposal in landfills used in this study.

Additional contact-provided and publicly available waste audits and characterization studies for the RD landfills have been used to estimate the total annual waste landfilled in the province, as outlined in the table below.

Table 3.1 Summary of Waste Audits and Characterization Studies

Waste Composition Study Author	Landfill	Year	Household Hazardous Waste %	Automotive HHW%
Tetra Tech	Golden Revelstoke Salmon Arm Sicamous	2018	0.9 1.5 1.6 1.5	0 (maximum of 2 for residential)
TRI Environmental Consulting Inc.	Regional District of Fraser-Fort George	2018	0.9	0.5
TRI Environmental Consulting Inc.	Columbia Shuswap	2013	5.7	0.3
TRI Environmental Consulting Inc.	Salmon Arm	2013	2.2	0.4
TRI Environmental Consulting Inc.	Metro Vancouver	2018	0.9	Motor Oil – 0 Oil Filters – 0 Oil Petroleum Based Products – 0
Maura Walker and Associates Environmental Consultants	Regional District of Nanaimo	2012	2.9	Oil and Filters – 0

Used oil is classified as a hazardous waste (HW) in the province of BC and therefore the percentage of HW received at each landfill through these waste audits has been estimated for the province based on the above data. It is assumed the landfilled HHW totals averages approximately 1.5 percent (as outlined above) of all waste landfilled, and within that 1.5 percent, a maximum estimated 0.5 percent is used oil (classified as automotive oil), based on waste audits and characterization studies specifying used oil quantities. These percentages were applied to the total tonnes of waste landfilled in BC (2.45 million tonnes) for 2017 (most recent data).

This estimated value has decreased since the CRA, 2013 study which may be attributed to the increased number of collection locations, diversion practices, and increased public education relating to used oil recycling and reuse. It is important to note that the calculations for this category were completed using information based on the 2018 Tetra Tech report and the data presented in



the table above from additional in-situ waste characterization studies (a slightly different estimation method than for the 2005 and 2013 studies).

3.2.2 Used Oil Filters and Containers

Used oil filters and containers not collected by BCUOMA are assumed to be landfilled. Most landfills in the RDs do not accept and recycle used oil filters, however, it is likely that filters can be found in mixed waste and are landfilled without RD knowledge. There are some landfills in the RDs that do accept used oil filters and containers and recycle them through the BCUOMA program. However, CRA's previous Used Oil Filter Study (CRA, 2007) identified that average volume of free product recovered per drum of collected oil filters was in the range of 10-20 L.

Tetra Tech conducted an oil filter study for BCUOMA in 2018 (BCUOMA Oil Filter Study) and determined that the average composition by weight of used motor oil in an average drum of oil filters by weight was 6.9%.

Ecowaste Industries estimated that less than 5 percent of the volume of oil in a filter remains in the filter after use (which is consistent with the above noted Tetra Tech study). Published values for the unaccounted oil that is landfilled with filters are between 60 mL to 240 mL per filter. The assumption that 300 mL (approximately 50% for a passenger car oil filter) used oil remains within each filter was made to account for some of the filters that are not drained prior to disposal.

Based on the above quantities, and the previous CRA, 2007 used oil container study, it has been assumed that plastic containers retain 10 to 20 percent residual volume of oil after use. An average of 15 percent residual was applied to the mass of unaccounted containers. This had been adjusted from the assumption made in the 2010 Greenhouse Gas Savings and Environmental Impact Reductions Study (CRA, 2013) of 10 percent residual by weight to account for the information provided by processors and unaccounted containers that have not been properly drained and contain considerably more residual oil.

As indicated previously, Tetra Tech conducted a 2018 Waste Characterization Study at the Golden, Revelstoke, Salmon Arm, and Sicamous landfills for the Columbia Shuswap Regional District. The results of this study indicated that Household Hazardous Waste (HHW) constituted 0.9%, 1.5%, 1.6%, and 1.5% of the landfilled waste respectively (assume 1.5% as a maximum average). The amount of used oil associated with rags and absorbent materials specifically cannot be determined from the above noted quantities, and it is possible that some leakage of oil had occurred during crushing and disposal and disintegration of containers. However, an average maximum amount of 0.5% as motor oil of the above noted 1.5% for HHW can be assumed as a basis for estimation. This quantity is consistent with previous studies was used as the basis in this Study for assuming used oil disposal associated with landfills.

3.2.3 DIY Other – Rags and Absorbent Materials

This section includes the remainder of the used oil that is landfilled but is not within a container or oil filter. Rags and absorbent materials used to clean up oil spills would be included in this category along with DIYs who dispose of their oil improperly which is disposed of in landfills. As described in Spence, 2006, farmers and truck owners/operators would contribute to this section as well, especially in more rural areas where collection and recycling of used oil is not feasible or practical,



resulting in landfill disposal. Convenience of disposal is another factor that would contribute a significant amount of unaccounted used oil to this category as through contact with the MOE, DIY oil changes are becoming more common. As a result more rural locations where this practice is assumed to take place would likely not have convenient drop-off or collection locations for DIYs to dispose of their used oil which would then end up in a landfill. DIYs are also not expected to be as diligent in preventing spills and recycling as commercial oil change locations.

Based on an annual disposal quantity of waste from BC landfills in 2017 (most recent data), a HHW quantity of 1.5 percent of all waste landfilled, and within that 1.5 percent, an estimated 5 percent is used oil, and a reported 2.45 million tonnes of waste disposed of in the province in 2017, and a used oil density of 0.9 kg/L, this category (oil in containers, filters, rags, and absorbent materials) comprises approximately **0.17 million L** of unaccounted used oil which is estimated to have been landfilled within the province in 2018.

3.2.4 Miscellaneous Unaccounted Used Oil

This category encompasses used oil sources like the sewer, toilet, road oiling, weed control etc., which cannot be accounted for because those at fault are not willing to admit to disposing used oil inappropriately. This results in unsubstantiated estimates for this category. Separating used oil from water from municipal wastewater is typically performed using an additive. Therefore, the amount of used oil removed from water is very difficult to estimate and justify. In order to acknowledge that this does occur, an estimate must be assigned to this category. An amount of 0.50 million L was used in the 2013 CRA study and was assigned to this category as it was for the 2005 study (Spence, 2006). The provincial population of British Columbia was used as a metric for determining unaccounted for used oil associated with miscellaneous unaccounted for used oil because most of these activities are likely associated with domestic activities. Changes in provincial population would most likely reflect this activity. For the purposes of this 2018 study, the population for the Province of British Columbia in 2011 (4.46 million) vs 2017 (4.99 million) was used to estimate an increase in miscellaneous used oil sources. Based on this increase in population as compared with 2011, it is estimated the total amount of used oil from sources like sewer, toilet, weed control etc. in 2018 is **0.57 million L** vs 0.5 million L in 2011.

The MOE representatives contacted as part of this study indicated that they were not aware of enforcement actions regarding illegal disposal of used motor oil.

4. Conclusion

GHD has prepared this Study to estimate the different uses or disposal methods of used oil that was not collected and processed through the British Columbia Used Oil Management Association (BCUOMA's) oil collection and recycling program in 2018 and quantify the unaccounted oil sources, and develop a report summarizing the review and study findings.

Based on the results of this Study, GHD concludes the following:

- **Used Oil Repurposed by Owner:**
 - **Used Oil Burners** – The amount of used oil combusted in oil burners has increased substantially, primarily due to a drop in crude oil prices, fuel charges and taxes, the carbon



tax, and decrease in the market for used oil in rural areas. Therefore, the total quantity of used oil estimated to be consumed by used oil burners in 2017 is **10.01 million L**. This represents a 52.7% increase over the 2011 Study.

- **Engine Oil Burn Systems** – The amount of fuel estimated to have been used in engine oil burn systems has not changed. Therefore, the total quantity of used oil estimated to be used in engine oil burn systems is **0.60 million L**. This is unchanged from the 2011 Study.
- **Pulp, Mill, Logging, and Construction** – The amount of used oil consumed in the pulp, mill, logging and construction industries is assumed to be unchanged from 2011 and is **6.30 million L**.
- **Cement and Lime Kilns** – The amount of used oil consumed in the cement industry is assumed to be unchanged since the last study. Therefore, the total quantity of unaccounted used oil attributed to the cement industry is **0 million L**. This represents a 100% decrease over the 2011 Study.
- **Mining Industry and Explosives Manufacturing** – Mining was not included in the previous 2011 study however is estimated at **1.43 million L** in 2018. The total unaccounted used oil in the explosives manufacturing industry for 2017 is **0.10 million L** and is a 93.8% decrease since the 2011 study.
- **Haida Gwaii and Very Remote Areas** – It has been reported in this Study that no used oil is collected and recycled from Haida Gwaii or very remote areas of the province. Due to market difficulties and increased burning, the unaccounted for used oil was estimated to have increased to **0.75 million L** in 2018. This represents a 45% increase over the 2011 Study.
- **Naval Vessels** – The amount of unaccounted used oil associated with marine activity and naval vessels is estimated to have increased in 2017 based on the increase in GDP for the province of BC from 2011 to 2017 and is estimated at **0.48 million L**. This represents a 19.6% increase over the 2011 Study.
- **Transformers and Insulating Oil** – The information on the amount of used oil was not included in the 2005 study. The amount of unaccounted used oil related to transformers and insulating oil is estimated to have increased in 2018 based on the increase in GDP for the province of BC from 2011 to 2018. Therefore, the total quantity of unaccounted used oil attributed to the use of transformers and insulating oil is **1.27 million L**. This represents a 23.3% increase over the 2011 Study.
- **Rail** – Used oil would be accounted for and recovered under the BCUOMA program or CIU. This industry has a high CIU ratio of 63.3%. This increased CIU ratio has resulted in an unaccounted used oil quantity associated with the difference between the CIU ratio for the rail industry of 63.3% and the standard BCUOMA CIU ratio assumption for this Study of 30.1%. Therefore, the total quantity of unaccounted used oil attributed to the rail industry is **1.12 million L**. Unaccounted used oil in the rail industry was not considered as part of the 2011 Study.
- **Disposal:**
 - **Landfills** – Based on waste composition studies and comments from Regional Districts as part of this Study, the amount of used oil landfilled has decreased slightly as participation in used oil recycling programs has increased. Therefore, the total quantity of used oil estimated



to be disposed in landfills in 2018 is **0.17 million L**. This represents a 91.5% decrease over the 2011 Study.

- **Miscellaneous Unaccounted Used Oil** – The amount of unaccounted used oil related to miscellaneous unaccounted for losses of oil is estimated to have increased in 2017 based on the increase in population for the province of BC from 2011 to 2017 to **0.57 million L**. This represents a 13.5% increase over the 2011 Study.

Therefore, the revised estimated unaccounted for used oil in BC in 2018 is **22.82 million L**. This represents a 10.6% increase over the 2011 Study.

Category	2018 Total	% Change from 2011
Repurposed By Owner		
Used Oil Burners	10.01 million L	52.7% increase
Engine Oil Burn Systems	0.60 million L	unchanged
Pulp, Mill, Logging, and Construction	6.30 million L	unchanged
Cement and Lime Kilns	0 million L	100% decrease
Mining Industry and Explosives Manufacturing	1.43 million L	Not included
Haida Gwaii and Very Remote Areas	0.75 million L	45% increase
Naval Vessels	0.49 million L	23.3% increase
Transformers and Insulating Oil	1.27 million L	23.3% increase
Rail	1.12 million L	Not included
Disposal		
Landfills	0.17 million L	91.5% decrease
Miscellaneous Unaccounted Used Oil	0.57 million L	13.5% increase

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Table 1

**Total Unaccounted Used Oil by Category
2018 Unaccounted Used Oil Study
BCUOMA**

Category	GHD, 2017 Unaccounted Used Oil (million L)	GHD, 2018 Unaccounted Used Oil (million L)	Percentage of Total	CRA, 2011 Unaccounted Used Oil (million L)	Percentage of Total	Spence, 2005 Unaccounted Used Oil (million L)	Percentage of Total	Percentage Change (from 2011 to 2018)	Change in Estimated Unaccounted Oil (from 2011 to 2017/2018)
Used Oil Burners	9.34	10.01	42.37%	6.56	32.9%	8.10	43.2%	52.7%	Increase
Landfill	0.17	0.17	0.75%	1.95	9.8%	2.55	13.6%	-91.5%	Decrease
Engine Oil Burn Systems	0.60	0.60	2.72%	0.60	3.0%	0.60	3.2%	0.0%	No Change
Pulp, Mill, Logging and Construction	6.30	6.30	28.57%	6.30	31.6%	2.40	12.8%	0.0%	No Change
Cement and Lime Kilns	-	-	0.00%	0.48	2.4%	0.60	3.2%		No Change
Mining Industry	1.43	1.43	6.49%	-	0.0%	-			<i>Not included in 2011</i>
Explosives Manufacturing	0.10	0.10	0.45%	1.60	8.0%	1.70	9.1%	-93.8%	Decrease
Haida Gwaii	0.75	0.75	3.42%	0.52	2.6%	0.40	2.1%	45.0%	Increase
Naval and Marine Vessels	0.48	0.49	2.17%	0.40	2.0%	0.40	2.1%	23.3%	Increase
Transformers and Insulating Oil	1.23	1.27	5.59%	1.03	5.2%	-	-	23.3%	Increase
Oil and Gas Industry	-	-	0.00%	-	0.0%	1.50	8.0%		<i>Not included in 2011</i>
Rail	1.08	1.12	4.89%	-	0.0%				<i>Not included in 2011</i>
Miscellaneous Unaccounted Catch All	0.57	0.57	2.57%	0.50	2.5%	0.50	2.7%	13.7%	Increase
TOTAL	22.05	22.82	100.00%	19.94	100.0%	18.75	100.0%	10.57%	Overall Increase

Appendices

Appendix A
List of Contacts that Provided Information
for this Study

Appendix A Companies That Provided Information For This Study

Oil Companies

- Formula Powell
- East Kootenay Fuel Sales Limited

Collectors & Processors

- Load Em' Up Petroleums Ltd.
- Safey Kleen/ Clean Harbours (Delta, Alberta)
- BC Greenhouse Growers
- GFL Environmental (Delta, Kelowna, Prince George)
- EcoWaste Industries Ltd.
- Castle Fuels Inc.
- Green Fever Trucking
- Nu-Plastic Services
- Revolution Environmental Solutions (Cranbrook, Kelowna, Port Alberni, Prince George)
- Canadian Tire

Pulp & Saw Mills

- Canfor Forest Products (Now Canfor Taylor Pulp)
- Catalyst Paper Corporation
- Domtar Inc.
- West Fraser Mills Ltd.

Mining Industry

- Teck Highland Valley
- Teck Coal Limited – Coat Mountain Operations

Cement & Paving Companies

- Cal Portland
- LeHigh Cement

Regional Districts

- Capital
- Cariboo
- Central Okanagan
- Columbia Shuswap

- Comox-Strathcona
- Kitimat-Stikine
- Kootenay Boundary
- Nanaimo
- North Okanagan
- Northern Rockies
- Okanagan-Similkameen
- Peace River
- Sunshine Coast
- Skeena-Queen
- Thompson-Nicola

Government – Ministry of Environment & Climate Change Strategy Regional Offices

- Kootenay
- Cariboo
- Skeena

Used Oil Burner Manufacturers & Distributors

- Clean Burn

Explosives Manufacturers

- Dyno Nobel
- Pashco Blasting Ltd.

Large Power Engines

- Cullen Diesel Power Ltd.
- CAT/Finning
- Cummins Western Canada

Vessels & Naval Uses

- None

Appendix B

Collection by Regional District Summary

Appendix B Collection by Regional District Summary

Oil (L) collected	2015	2016	2017	2018
Alberni-Clayoquot	428,010.42	388,992.63	408,595.91	415,987.64
Port Alberni	229,586.80	205,581.99	211,810.88	235,306.27
Tofino	29,187.05	27,730.02	29,515.07	26,868.19
Ucluelet	21,538.42	20,689.89	23,129.08	24,152.59
Unincorporated Areas	147,698.14	134,990.74	144,140.88	129,660.60
Bulkley-Nechako	473,660.90	512,611.47	603,751.93	463,981.29
Burns Lake	20,888.39	22,459.48	23,075.91	20,298.39
Fort St. James	20,283.10	21,861.56	22,485.23	17,940.44
Fraser Lake	13,122.34	14,674.03	15,331.44	11,400.46
Granisle	3,471.88	3,824.22	4,003.50	3,436.82
Houston	35,632.47	39,300.98	39,418.07	34,879.86
Smithers	56,326.71	68,038.65	71,275.44	63,464.44
Telkwa	15,440.74	16,542.54	17,221.62	15,615.86
Vanderhoof	68,170.27	65,950.54	73,977.23	70,081.35
Unincorporated Areas	240,325.01	259,959.48	336,963.49	226,863.67
Capital	2,524,279.12	2,552,278.29	2,677,792.79	2,740,234.62
Central Saanich	107,209.15	106,021.15	110,739.70	120,233.17
Colwood	113,282.51	117,280.27	122,617.59	121,366.64
Esquimalt	111,558.72	112,257.69	115,425.28	124,733.88
Highlands	15,166.69	15,968.21	17,492.40	16,246.29
Langford	249,047.81	266,376.89	261,716.70	260,948.21
Metchosin	33,219.74	31,963.09	32,539.56	33,639.31
North Saanich	73,454.91	74,324.86	75,768.55	80,270.34
Oak Bay	116,750.14	115,846.20	127,842.77	127,451.54
Saanich	740,315.08	739,640.10	791,386.17	810,292.98
Sidney	73,929.28	74,231.48	77,517.10	82,795.78
Sooke	81,385.68	79,160.68	95,330.53	94,773.36
Victoria	566,532.82	568,238.69	588,293.96	610,087.75
View Royal	72,385.89	67,614.75	70,898.54	75,020.62
Unincorporated Areas	170,040.69	183,354.23	190,223.93	182,374.75
Cariboo	944,898.82	919,620.99	1,033,853.82	985,605.72
One Hundred Mile House	29,031.55	27,102.96	32,550.63	28,551.66
Quesnel	139,011.50	131,522.22	142,243.82	157,366.13
Wells	3,520.82	3,366.01	3,883.23	3,516.14
Williams Lake	170,198.04	160,694.34	186,297.31	171,415.60
Unincorporated Areas	603,136.92	596,935.45	668,878.82	624,756.20
Central Coast	39,588.72	22,919.45	23,830.82	32,067.21
Central Kootenay	1,213,149.46	1,250,952.12	1,351,327.07	1,465,563.56
Castlegar	160,535.40	163,308.17	176,619.51	200,138.71
Creston	95,760.08	95,938.92	102,033.50	132,365.64
Kaslo	20,145.14	20,583.33	21,913.53	23,573.24
Nakusp	30,661.80	32,336.42	37,737.50	39,662.92
Nelson	218,043.93	231,541.92	249,360.88	264,567.57
New Denver	10,557.02	10,682.75	11,401.26	11,669.69
Salmo	23,839.09	23,979.58	25,602.83	27,595.66
Silverton	3,976.55	4,096.08	4,311.59	4,724.00
Slocan	6,055.65	6,360.25	7,645.29	7,015.85
Unincorporated Areas	643,574.78	662,124.69	714,701.18	754,250.27
Central Okanagan	2,527,859.28	2,505,368.15	2,374,465.29	2,463,491.35
Kelowna	1,608,046.53	1,598,464.93	1,518,513.86	1,606,921.73
Lake Country	181,454.38	180,305.15	158,541.77	165,453.97
Peachland	64,811.60	63,042.60	60,571.21	66,891.67
West Kelowna	445,833.48	444,056.88	400,588.08	411,458.68
Unincorporated Areas	227,713.29	219,498.60	236,250.37	212,765.29
Columbia-Shuswap	744,729.46	749,307.97	745,947.03	794,050.82
Golden	76,059.02	79,492.84	81,986.84	92,001.13
Revelstoke	145,174.23	150,587.67	163,040.24	190,106.05
Salmon Arm	222,153.95	230,457.00	234,473.42	227,639.28
Sicamous	31,584.83	31,375.10	29,289.80	30,325.95
Unincorporated Areas	269,757.44	257,395.35	237,156.73	253,978.40
Comox	918,887.46	821,099.74	887,679.18	895,210.02
Comox	198,835.91	182,334.36	193,524.96	187,701.89
Courtenay	358,888.43	329,923.90	351,296.43	344,556.05
Cumberland	49,844.04	45,102.43	49,625.57	51,734.09
Unincorporated Areas	311,319.08	263,739.06	293,232.23	311,217.98
Cowichan Valley	553,130.01	560,381.31	583,710.83	599,077.92
Duncan	31,155.20	31,803.01	34,424.72	34,739.63
Ladysmith	54,633.51	55,641.93	61,124.38	62,419.97
Lake Cowichan	20,805.76	21,137.53	20,600.19	23,265.81
North Cowichan	200,434.21	201,630.29	209,116.54	211,579.63
Unincorporated Areas	246,101.33	250,168.56	258,444.99	267,072.89

Oil (L) collected	2015	2016	2017	2018
East Kootenay	1,163,533.47	1,215,631.12	1,292,453.90	1,496,807.46
Canal Flats	14,775.80	15,314.00	16,335.14	16,089.67
Cranbrook	401,913.79	420,970.35	439,404.10	498,312.19
Elkford	52,643.82	54,134.17	57,517.47	61,224.95
Fernie	86,959.20	89,187.59	99,010.94	125,911.06
Invermere	61,121.74	60,535.59	65,985.07	84,213.54
Kimberley	136,171.49	145,112.50	156,795.10	187,837.60
Radium Hot Springs	15,179.51	15,725.67	17,424.15	21,959.60
Sparwood	76,059.02	83,938.84	84,409.33	93,848.64
Unincorporated Areas	318,709.10	330,712.43	355,572.62	407,410.20
Fraser Valley	2,258,779.48	2,282,109.08	2,280,490.58	2,495,866.38
Abbotsford	1,078,264.79	1,071,857.48	1,089,570.81	1,188,203.52
Chilliwack	661,881.05	684,773.63	662,947.02	711,179.57
Harrison Hot Springs	10,500.85	10,659.11	11,008.19	12,826.59
Hope	43,542.70	43,909.15	44,460.78	52,080.64
Kent	47,208.09	47,121.27	47,592.04	51,806.90
Mission	294,991.51	302,068.58	300,412.53	324,598.72
Unincorporated Areas	122,390.50	121,719.86	124,499.21	155,170.43
Fraser-Fort George	1,503,422.23	1,409,579.03	1,603,665.09	1,675,232.70
Mackenzie	171,309.60	135,696.10	189,417.55	218,962.21
McBride	8,756.51	8,393.18	9,300.18	9,658.07
Prince George	1,082,999.77	1,033,293.14	1,147,283.40	1,187,263.14
Valemount	14,493.01	13,799.20	15,532.93	16,237.62
Unincorporated Areas	225,863.34	218,397.42	242,131.03	243,111.65
Metro Vancouver	19,156,570.58	19,379,033.25	19,465,030.55	20,758,941.59
Anmore	17,092.45	17,590.93	18,006.58	18,684.59
Belcarra	4,747.48	4,681.82	4,708.14	5,349.63
Bowen Island	27,021.77	27,121.25	27,205.10	31,104.48
Burnaby	1,815,236.80	1,808,547.85	1,760,357.22	1,943,353.27
Coquitlam	1,102,421.31	1,118,327.24	1,127,431.18	1,169,174.81
Delta	767,003.83	772,705.57	771,016.53	856,284.27
Langley, City of	211,373.37	206,689.67	205,468.75	215,682.21
Langley, District Municipality	890,537.38	927,387.59	959,124.47	995,546.60
Lions Bay	10,150.31	10,037.89	9,904.37	11,004.27
Maple Ridge	619,130.87	648,887.22	658,636.85	693,151.96
New Westminster	546,112.64	558,871.95	555,125.30	600,651.92
North Vancouver, City of	413,465.14	399,955.08	404,104.30	443,776.49
North Vancouver, District Municipality	655,152.28	656,076.63	644,587.51	710,264.51
Pitt Meadows	149,755.19	144,621.40	147,026.20	154,638.60
Port Coquitlam	459,232.99	463,538.49	467,014.70	491,508.61
Port Moody	263,313.70	259,038.22	254,232.19	278,532.49
Richmond	1,583,303.72	1,616,608.20	1,646,520.79	1,691,701.86
Surrey	4,008,336.45	4,120,763.03	4,179,253.67	4,450,708.83
Vancouver	4,942,622.28	4,947,324.74	4,927,134.97	5,263,304.48
West Vancouver	317,982.11	310,023.14	328,909.18	351,057.47
White Rock	147,278.57	146,121.41	144,075.17	167,136.70
Unincorporated Areas	205,299.95	214,113.92	225,187.38	216,323.54
Kitimat-Stikine	524,278.72	515,075.49	528,221.21	545,783.88
Hazelton	3,003.63	3,201.38	3,386.57	3,559.17
Kitimat	93,775.06	95,468.37	97,409.76	94,685.03
New Hazelton	7,457.69	7,997.22	8,374.54	6,773.54
Stewart	88,020.82	68,539.12	57,908.34	116,203.27
Terrace	127,500.28	132,776.27	135,055.79	136,227.20
Unincorporated Areas	204,521.23	207,093.12	226,086.21	188,335.67
Kootenay-Boundary	592,424.69	615,976.85	649,071.71	775,227.65
Fruitvale	41,662.90	43,183.83	45,649.49	46,889.24
Grand Forks	79,450.19	82,930.25	87,965.27	101,121.73
Greenwood	13,968.38	14,161.33	15,046.11	16,042.90
Midway	13,221.51	13,729.08	14,779.41	15,785.65
Montrose	20,387.37	20,995.00	22,158.00	23,994.19
Rossland	72,163.22	74,902.75	79,608.80	91,416.48
Trail	150,341.72	151,822.67	159,239.82	191,439.06
Warfield	33,548.33	34,353.58	36,515.15	41,019.32
Unincorporated Areas	167,681.07	179,898.34	188,109.67	247,519.06
Mount Waddington	161,886.49	141,043.23	149,279.18	145,090.72
Alert Bay	6,255.38	5,520.68	5,795.69	5,931.78
Port Alice	11,145.96	9,939.76	10,410.77	8,797.55
Port Hardy	56,056.77	47,242.33	50,108.54	54,975.29
Port McNeill	35,200.75	31,655.27	34,170.40	30,196.99
Unincorporated Areas	53,227.63	46,685.19	48,793.78	45,189.12
Nanaimo	1,220,587.03	1,200,868.74	1,265,187.97	1,264,469.95
Lantzville	48,180.67	43,152.47	45,332.47	47,078.77
Nanaimo	604,823.72	622,659.99	647,123.35	647,061.15
Parksville	179,103.01	163,125.94	174,420.65	166,727.94
Qualicum Beach	127,098.03	109,995.74	118,221.28	118,910.82
Unincorporated Areas	261,381.61	261,934.61	280,090.22	284,691.26

Oil (L) collected	2015	2016	2017	2018
North Okanagan	1,093,600.41	1,082,669.91	1,030,998.52	1,058,494.95
Armstrong	64,010.02	61,555.21	58,150.27	64,249.50
Coldstream	139,901.52	139,052.22	132,173.79	134,408.50
Enderby	36,717.52	35,786.43	33,320.72	36,825.22
Lumby	22,664.02	22,527.02	19,367.52	22,753.31
Spallumcheen	67,319.77	66,386.06	61,060.17	63,954.62
Vernon	523,573.79	529,753.63	503,257.41	502,177.05
Unincorporated Areas	239,413.77	227,609.34	223,668.64	234,126.75
Northern Rockies	1,242,511.92	970,889.91	773,734.42	1,002,979.50
Northern Rockies Regional Municipality	1,119,241.06	872,375.05	693,847.23	894,402.07
Unincorporated Areas	123,270.87	98,514.86	79,887.19	108,577.43
Okanagan-Similkameen	1,058,098.18	1,024,928.54	1,039,465.85	1,044,423.04
Keremeos	18,500.98	17,136.81	16,040.22	18,754.67
Oliver	59,433.26	58,071.91	55,824.73	63,164.33
Osoyoos	62,006.07	61,021.27	58,031.01	59,838.03
Penticton	439,110.55	419,724.65	416,628.30	432,265.76
Princeton	35,282.44	35,366.91	32,736.36	34,454.34
Summerland	145,667.72	144,607.70	138,947.66	144,057.13
Unincorporated Areas	298,097.16	288,999.29	321,257.57	291,888.79
Peace River	3,129,398.90	2,584,287.90	3,423,654.76	3,740,235.59
Chetwynd	131,505.45	111,797.73	149,696.53	152,388.17
Dawson Creek	584,773.31	470,778.42	651,380.70	725,049.84
Fort St. John	1,017,282.31	878,915.91	1,120,275.78	1,221,148.52
Hudson's Hope	50,575.25	39,714.04	55,895.51	60,785.00
Pouce Coupe	34,908.19	26,773.94	37,960.53	47,390.73
Taylor	73,439.38	59,998.50	90,720.17	87,346.51
Tumbler Ridge	129,596.03	110,865.11	112,011.07	123,102.40
Unincorporated Areas	1,107,318.99	885,444.25	1,205,714.48	1,323,024.41
Powell River	240,925.27	143,444.17	148,351.46	195,404.14
Powell River	159,655.10	96,878.44	99,889.29	126,933.09
Sechelt Ind Gov Dist (Part-Powell River)	272.43	148.19	155.66	201.28
Unincorporated Areas	80,997.75	46,417.54	48,306.51	68,269.77
North Coast	177,623.75	189,603.87	192,469.93	187,012.10
Masset	933.76	-	-	-
Port Clements	389.07	-	-	-
Port Edward	5,710.33	5,904.49	6,169.33	5,349.88
Prince Rupert	130,035.67	140,275.23	140,621.32	142,600.34
Queen Charlotte	1,005.18	-	-	-
Unincorporated Areas	39,549.76	43,424.16	45,679.29	39,061.88
Squamish-Lillooet	522,035.27	527,973.84	516,077.66	535,428.26
Lillooet	31,196.97	30,548.77	27,751.37	28,096.63
Pemberton	31,623.61	31,921.75	30,446.60	33,239.42
Squamish	238,780.26	242,394.29	236,751.25	250,404.39
Whistler	133,954.32	135,098.55	126,198.96	140,376.97
Unincorporated Areas	86,480.11	88,010.47	94,929.48	83,310.86
Stikine	136,619.99	109,208.91	84,493.54	130,183.98
Strathcona	646,124.29	584,672.86	624,807.23	602,275.42
Campbell River	474,769.42	426,662.40	452,090.40	439,764.80
Gold River	17,657.24	15,878.28	16,769.93	15,755.50
Sayward	4,364.55	3,937.92	4,212.61	4,017.09
Tahsis	4,307.68	3,735.32	3,957.70	3,228.69
Zeballos	1,435.89	1,253.55	1,328.18	1,276.46
Unincorporated Areas	143,589.49	133,205.38	146,448.42	138,232.89
Sunshine Coast	377,220.84	371,759.39	350,499.67	377,181.27
Gibsons	58,011.10	57,843.08	55,025.70	58,304.63
Sechelt Ind Gov Dist (Part-Sunshine Coast)	10,161.96	10,564.31	9,946.13	8,068.05
Sechelt District Municipality	126,352.24	120,644.14	114,392.41	128,711.32
Unincorporated Areas	182,695.54	182,707.86	171,135.43	182,097.27
Thompson-Nicola	1,721,987.21	1,717,164.01	1,650,806.91	1,678,472.58
Ashcroft	20,104.14	19,793.78	18,258.42	18,731.08
Barriere	22,741.59	22,260.05	20,917.88	21,479.41
Cache Creek	12,695.99	12,356.81	11,246.04	11,170.24
Chase	30,460.03	30,065.69	27,536.70	28,073.03
Clearwater	30,472.96	30,103.83	28,216.48	28,780.76
Clinton	8,145.08	7,996.33	7,417.86	7,808.55
Kamloops	1,163,518.85	1,161,972.14	1,100,955.35	1,146,240.87
Logan Lake	27,111.50	26,684.09	24,710.29	25,029.82
Lytton	3,115.82	3,051.06	2,933.75	3,031.42
Merritt	98,387.45	96,706.00	92,270.02	89,562.42
Sun Peaks Mountain	6,076.49	5,809.73	5,533.58	8,327.55
Unincorporated Areas	299,157.32	300,364.50	310,810.56	290,237.43
British Columbia	47,295,822.38	46,349,452.23	47,759,714.83	50,564,781.30

Appendix B Collection by Regional District Summary

Oil (L) collected		2015	2016	2017	2018
Zone					
	1	21,415,350.06	21,661,142.33	21,745,521.13	23,254,807.97
	2	2,345,181.72	2,259,454.46	2,522,078.60	2,511,957.55
	3	3,300,708.50	2,719,984.00	3,613,072.31	3,959,197.80
	4	7,824,297.41	7,749,091.30	7,463,233.86	7,669,435.09
	5	1,467,152.74	1,148,637.95	916,136.30	1,249,366.75
	6	3,190,340.86	3,312,640.60	3,537,879.76	4,019,705.85
	7	3,943,614.45	3,997,254.20	4,188,717.19	4,271,064.95
	8	2,509,290.37	2,252,082.60	2,408,335.90	2,391,281.34
	9	1,017,044.28	1,082,801.17	1,192,557.50	1,010,492.65
	10	280,513.99	166,363.62	172,182.28	227,471.35
	11	2,328.00	-	-	-
		47,295,822.38	46,349,452.23	47,759,714.83	50,564,781.30



about GHD

GHD is one of the world's leading professional services companies operating in the global markets of water, energy and resources, environment, property and buildings, and transportation. We provide engineering, environmental, and construction services to private and public sector clients.

Deacon Liddy
Deacon.Liddy@ghd.com
604.214.0510

www.ghd.com