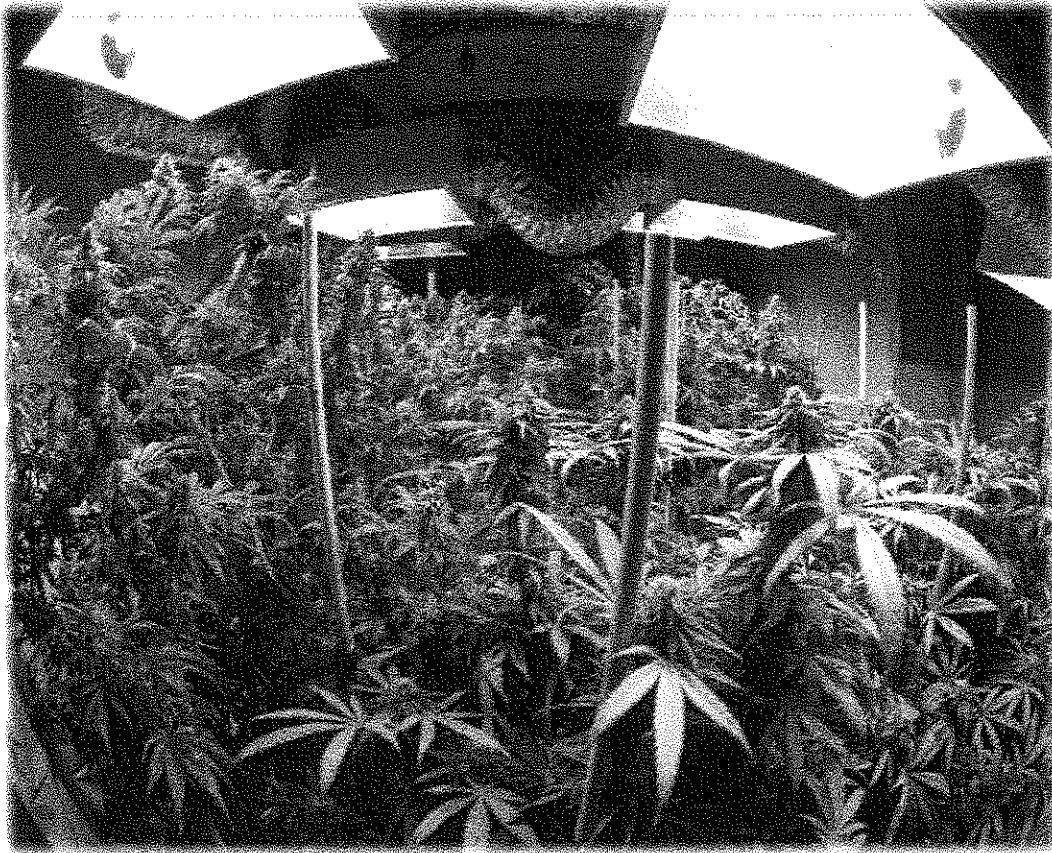


Appendix H: Plecas et al (2012) Revisiting the Issues Around Commercially Viable Marihuana Growing Operations In British Columbia

**REVISITING THE ISSUES AROUND COMMERCIALY VIABLE INDOOR
MARIHUANA GROWING OPERATIONS
IN BRITISH COLUMBIA**



Darryl Plecas, Jordan Diplock, and Len Gatis



Introduction

Media reports of law enforcement efforts targeted at marijuana growing operations or 'grow ops' in British Columbia has come to be so common in recent years we can appreciate why many people might have started taking them for granted. Indeed, any new media report about grow ops almost seems like old news. Further, while these reports will from time to time give attention to the violence, organized crime activity, and other harms associated to one aspect or another of marijuana industry in the province, few of them really get into the details. Consequently, most British Columbians might have some sense that marijuana growing operations are a problem, but they do not get a level of the information that would be helpful to fully appreciating why grow ops in British Columbia are an extremely serious matter.

The issue of grow ops is also commonly linked to the very public and long-standing debate about the de-criminalization of marijuana, with its adjoining suggestions that marijuana is a benign drug, and that organized crime and the associated violence would largely disappear if government authorities would simply remove the criminal status of marijuana possession and production. Accordingly, attention regarding the seriousness of the matter of marijuana grow ops is often overshadowed by arguments that the only reason marijuana grow ops are a problem is because of the way the government has chosen to look at them.

With the above in mind, and in the spirit of making more detailed information available, the purpose of this report is to call attention to what we have come to know about the harms associated to marijuana grow operations. Further, the purpose is to provide information about the number and commercial viability of grow operations so as to give the reader an appreciation that growing operations in British Columbia are not primarily so called "ma and pa" personal use operations, but rather highly profitable investments collectively contributing to a multi-billion dollar and largely export illicit drug industry.

The report is organized in a question and answer format. This format was selected to provide straightforward answers to some of the most pressing questions related to marijuana production that face policy makers, prosecutors, law enforcement, and the public as a whole. The report looks first at why marijuana use should be of concern to British Columbians. The question is relevant of course, because there would be less reason to care about growing operations if the product being produced was harmless. Subsequent sections focus specifically on questions related to indoor marijuana cultivation, first addressing the potential harms, and then providing information on the nature of the marijuana industry. Through the answers to following questions, we hope to emphasize why indoor marijuana growing operations should be considered an issue of great concern, and one which requires further effort to properly address.

What are the Harms of Marijuana Use?

Recently, the authors updated their review on the risks and harms associated to marijuana use (Diplock, Plecas, and Garis, 2012), providing a detailed summary of the state of literature on the topic covering more than ten years. The review concluded that the most recent evidence suggests that, despite the common argument that the drug is harmless, marijuana poses some considerable risks to users. There are a number of serious risks to users of the drug, specifically when it is smoked. Those risks related to a user's health are perhaps of most concern. Smoking marijuana can cause considerable harm to the lungs and airways. This is a particular risk to those who are considered heavy smokers, as they will likely experience an accelerated decline in lung functioning (Pletcher et al., 2012). The inhalation of marijuana smoke can lead to common respiratory ailments such as coughing on most days, wheezing, shortness of breath after exercise, nocturnal chest tightness, chest sounds without a cold, early morning phlegm and mucus, and acute and chronic bronchitis which may affect as much as 40% of the user population (Moore et al., 2005). Marijuana use may also be associated to chronic obstructive pulmonary disease (Aldington et al., 2007), bullous lung disease (Hü, Tam, Thomson, & Naughton, 2008), collapsed lung (Beshay, Kaiser, Neidhart, Reymond, & Schmid, 2007; Gill, 2005), pulmonary fibrosis, byssinosis, and lung tumours (Phan, Lau, & Li, 2005). Additionally, Δ^9 -tetrahydrocannabinol (THC), the main active drug in marijuana, poses a risk to the user's immune system, potentially inhibiting the ability of the lungs to defend against foreign pathogens (Shay et al., 2003).

There are other health concerns as well, including potential cardiovascular risks, cancers, and reproductive problems (Diplock & Plecas, 2012). Researchers have found that marijuana use may cause heart attacks (Ayana & Williams, 2007; Lindsay, Foale, Warren, & Henry, 2005; Mukamal, Machure, Muller, & Mittleman, 2008), hypertension (Vandrey et al., 2011), coronary vasospasms (Safaa et al., 2012), and symptoms of Brugada Syndrome¹ (Pratap & Korniyenko, 2012). While the likelihood of such an event occurring is very low for most users, the consequences can be very serious. Similarly, some researchers have seen links between marijuana use and cancers (Aldington et al., 2008; Berthiller et al., 2008; Cho, Hirsch, & Johnstone, 2005; Daling et al., 2009; Trabert, Sigurdson, Sweeney, Strom, & McGlynn, 2011). While the questions whether or not marijuana causes cancer has yet to be answered conclusively (Mehra, Moore, Crothers, Tetrault, & Fiellin, 2006), marijuana smoke contains many of the same carcinogenic chemicals as tobacco smoke, and therefore, the possibility remains a concern. Marijuana use can also be detrimental to the fertility of both males and females (Bari, Battista, Pirazzi, & Maccarrone, 2011), and intrauterine exposure to a foetus can result in low birth weight, reductions to head and body growth, and preterm labour (El Marroun et al., 2009; Hayatbakhsh et al., 2012).

¹ Brugada Syndrome is a heart condition that is closely linked to sudden death in young people.

Marihuana use is associated to risks related to the overall lifestyle of users. A large amount of research has demonstrated a link between marihuana use and psychosis and later schizophrenia (Arendt, Rosenberg, Foldager, Petro, & Munk-Jorgensen, 2005; Degenhardt & Hall, 2006; D'Souza, Sewell, & Raganathan, 2009; Linszen & Van Amelsvoort, 2007; McLaren, Silins, Hutchinson, Mattick, & Hall, 2010; Moore et al., 2007). While there is currently not enough evidence to support a causal link (McLaren et al., 2010), research suggests that marihuana use may put youth at particular risk since their brains are in the process of developing (Malone, Hill, & Rubino, 2010). Dependency is also a real risk for some users (Hall, 2006; Hasin et al., 2008; Looby & Earlywine, 2007). Academic performance and social development appear to be negatively affected by marihuana use (Fergusson & Boden, 2008; Finn, 2012; Lynskey & Hall, 2000; van Ours & Williams, 2009). Furthermore, findings regarding the drug's ability to cause short-term impairment, specifically to negatively affect driving ability (Bedard, Dubois, & Weaver, 2006), should be a concern to users and others. All of the harms discussed may be compounded by the fact the marihuana users have an increased likelihood of continuing on to other illicit drugs (Fergusson, Boden, & Horwood, 2006; Lynskey, Vink, & Boomsma, 2006).

While the most serious of the harms discussed here are not experienced by the majority of users, marihuana use is associated to health problems that range from those that might be considered minor to those that are life altering. It is important to recognize that marihuana is neither harmless, nor is it particularly dangerous to the majority of users. However, given that marihuana is a widely used substance, it must be acknowledged that the lives of a small proportion of the population will be seriously disrupted by marihuana use.

What are the Potential Economic Costs of Marihuana Use?

The risks associated to marihuana use are likely to translate into economic costs in terms of health care expenditure and loss of productivity. While substance use, including use of marihuana, has declined steadily in recent years, there is still approximately 12.6% of the population of those 15 years old and over using marihuana in a given year in British Columbia (Health Canada, 2011). Even if only a small portion of the user population is afflicted by serious health problems, the associated costs put increased pressure on our health care system and consequently on tax payers. Therefore, the harms of marihuana use cannot simply be understood in terms of potential risks to only the users themselves, but instead that the burden of marihuana use is faced collectively by all British Columbians.

Despite a belief among many users that the effects of marihuana smoking are benign compared to the widely accepted consequences of tobacco use, experts emphasize that marihuana smoking should be viewed as at least as harmful as tobacco, specifically to the lungs (Taylor & Hall, 2003). While tobacco smoking has also been on the decline, a media release from the Government of British Columbia (Office of the Premier, 2011) suggests that tobacco use costs the province \$2.3 billion annually, with over \$600 million of that in direct health costs for the

estimated 550,000 British Columbians who smoke. Using the 12.6% figure reported by Health Canada (2011) in conjunction with population statistics for 2010 (BC Stats, 2012)², we can approximate the number of marijuana users in the province at 484,235. It remains inconclusive as to whether marijuana smoking presents the same risks of lung cancer (Aldington et al., 2008; Sewell, Cohn, & Chawarski, 2008; Mehra et al., 2006) and respiratory ailments such as COPD (Aldington et al., 2007; Tan et al., 2009; Taskin, 2009) that have been found for tobacco, and therefore it is difficult to speculate the amount of strain marijuana use puts on the health care system. However, in addition to some of the health consequences that marijuana smoking may share with tobacco smoking, marijuana use may be a factor in psychosis and later schizophrenia. The increased costs for mental health care and loss of productivity from these mental illnesses suggests the potential for the costs of marijuana to be nearly as high as those for tobacco.

Because many marijuana users are also tobacco smokers and some may also partake in other unhealthy choices, it is difficult to estimate the extent to which marijuana use alone has put an economic burden on British Columbians. Despite this difficulty, it is apparent that marijuana use does put an added economic strain on British Columbia's health care system, tax payers, and the province's legitimate economy as a whole, potentially in the range of hundreds of millions of dollars. This is of particular concern since the illegal marijuana production industry is fuelling these problems while remaining free from taxation.

What are the Dangers of Indoor Marijuana Production?

The illicit nature of marijuana growing ultimately leads those who undertake in these operations to hide their activities from the authorities and the public. In order to avoid detection, along with other reasons, marijuana growing operations are often located indoors, in homes and other buildings that require substantial changes to make the environment suitable for growing. Although not all marijuana grow ops are large and sophisticated endeavours,³ those that operate indoors with the intention of making commercial profit require large amounts of energy (commonly electricity), structural and mechanical changes to the site, pesticides, herbicides, and fertilizers, as well as measures to protect the site from detection. The changes made to facilitate the growing of marijuana involve practices that generally require specific training, certification, and inspection to ensure proper function and safety. The illicit and clandestine nature of marijuana growing operations prevents the regulation and maintenance of safety standards within these sites.

² There were 3,843,137 British Columbians aged 15 and over in 2010.

³ According to estimates of the prevalence of marijuana growing operations in Quebec for 2000-2001 by Bouchard (2007), approximately 20% of indoor marijuana growing operations (both soil-based and hydroponic) involved 20 plants or fewer.

Furthermore, when a marijuana growing site is located within a residential neighbourhood, the risks associated to errors in or abuses of construction, ventilation, chemical usage, waste disposal, plumbing, electrical work, and security are assumed by others without their knowledge and consent.

To determine the nature and extent of the dangers of indoor marijuana growing operations, we elicited the help of a focus group of professionals in the field of environmental consulting and industrial hygiene. According to the focus group, who have seen marijuana grow ops first hand and have been responsible for the remediation process (Surrey Fire Service focus group, July 10, 2009), growing sites have one type of contamination or another in every case. The focus group identified improper ventilation in approximately 90% of growing sites, leading to high levels of relative humidity around 80%. Due to the high levels of moisture within grow ops, individuals within the site are often ultimately exposed to mould. Similar findings were reported by Johnson and Miller (2011), who argued that the often extensive mould damage found in marijuana growing operations can put residents' health at risk.

Growers may also try to improve the yield of their operation by using carbon dioxide (CO₂) (Surrey Fire Service focus group, July 10, 2009). CO₂ is used to increase the rate of growth and tolerance to higher temperatures in growing sites. Exposure to higher than normal levels of CO₂ can be dangerous, and the problem may be further compounded when the increase of the gas coincides with displacement of oxygen (O₂). Furthermore, in many cases, unsafe modifications are made to the home to achieve higher levels. For example, some operations have been found with the home's furnace disconnected and the exhaust re-vented into the growing room(s) (Johnson & Miller, 2011).

Chemical residues are almost always left behind by marijuana growing operations (Surrey Fire Service focus, July 10, 2009). Fertilizers are a common cause of these residues, as are herbicides and pesticides in more advanced grow ops. These chemicals are also used to increase the output of a growing operation. According to the focus group (Surrey Fire Service focus group, July 10, 2009), these chemicals are often found in high concentrations at growing sites, along with signs of spillage and on-site dumping. In testing residual pesticides in former growing operations, Blair and Wedman (2009) found the presence of 15 different pesticides used in 139 homes. The average levels found for the two most common pesticides were just below and just at the acceptable safe level, although the maximum levels found for most chemicals found were above a safe level (Blair & Wedman, 2009).

Because indoor marijuana grow ops require a great deal of electricity to power the typically 1000 watt bulbs used to provide the plants with light, these operations are susceptible to serious electrical hazards including fire. Garis (2008) outlined many of the

electrical hazards common to marijuana growing operations that can increase the risk of fires. These included inadequate electrical protection of fuses and circuit breakers, improper installation of electrical systems, failure to enclose electrical by-passes, and improper monitoring of grow sites (Garis, 2008). Improper installation of electrical systems puts those within the grow site at risk of shock and electrocution, especially considering the high likelihood of the presence of water (Garis, 2008). Electrical by-passes are only one of many electrical hazards that inflate the risk of residential fires in marijuana growing operations to what Plecas, Malm, and Kinney (2005) estimated was 24 times as great as that faced by a regular home⁴.

The danger presented to those living within marijuana grow ops is evident, as many of the previously described hazards are present in the vast majority of cases. Of particular concern is that the previously discussed dangers such as high humidity, increased CO₂ levels, high energy light systems, and improper and unregulated construction and electrical work make marijuana grow sites much more hazardous to children than a typical home. Of course, it is difficult to estimate the true number of children who live in and around marijuana growing sites on a daily basis, but it is evident that children have been exposed to the potential harms of marijuana production (Plecas et al., 2005). Data from child protection workers obtained and presented by Douglas (2010) indicated that the homes housing marijuana growing operations from which children were seized exhibited illegal wiring (90%), unlocked access to the growing operation (58%), electrical bypasses (73%), flammable gases (propane and butane) being used indoors (57%), pesticides and chemicals (96%), re-venting of the furnace or hot water tank exhaust (59%), and mould (77%)⁵. While approximately 20% of children from Douglas' (2010) study were found to be unhealthy, comparisons between children from homes used as growing operations and a comparison group were not significant on a number of measures of health and medication requirements. Research by Moller, Koren, Karaskov, and Garcia-Bournissen (2011) found that although just over 26% of children seized from marijuana producing homes tested positive for drug contamination⁶, the large majority were considered healthy. So, despite the presence a large variety of serious risks, there is little evidence available to indicate

⁴ This figure assumes that those growing operations that did not come to the attention of police had the same likelihood of catching fire as those that did. However, it can be argued that the vast majority of growing operations that caught fire would have been discovered by police, and therefore, the actual risk is much lower. We still maintain that even if only one fifth of all marijuana growing operations came to the attention of police, the probability of a growing operation catching fire is nearly five times as great as that faced by a normal residence.

⁵ Of those houses with mould, only 5% were deemed to be excessive levels.

⁶ Tested using hair samples. The majority of children (10 of 15) tested positive for cannabinoids, while the remainder tested positive for cocaine, opiates, methamphetamines, and MDMA.

that children are often seriously harmed by living in or around marijuana growing operations.

However, these dangers are not limited to only the grow operators, but pose a serious threat to neighbours and first responders. Contamination from the chemicals used in the growing process is a major health concern for people in neighbouring properties. According to the focus group (Surrey Fire Service focus group, July 10, 2009), there is a real risk of drinking water contamination in the neighbourhood as a result of back flushing. Also, the spilling and dumping of chemicals can result in the migration of substances into neighbouring properties, which would require remediation to eliminate the danger. All of the aforementioned hazards present serious risks to law enforcement, fire crews, and other first responders who may enter the residence without prior knowledge that a grow op exists. Also, there is some indication that booby traps are sometimes (although uncommonly) used by grow operators to dissuade entrance into the grow site, posing another threat to emergency responders (Garis, 2008; Gustin, 2010; Plecas et al., 2005; Surrey Fire Service focus group, July 10, 2009).

What Problems Do Marijuana Growing Operations Cause in Communities?

In addition to the health risks identified above, there is also the potential for marijuana production to cause social problems to communities. These problems include attracting and supporting criminal activity, lowering property values, increasing living costs, and impacting the environment. These problems may be of most concern for those living within close proximity to marijuana growing operations, but the negative effects of marijuana production influence all British Columbians.

Currently, there are no studies that investigate whether the presence of a marijuana growing operation causes a rise in other types of crimes in the surrounding neighbourhood. However, based on the findings of Plecas et al. (2005), between 1997 and 2003, 9% of all investigations of marijuana production started while responding to another crime, and another 3% began as a result of serving a warrant. These findings indicate that other crime does occur around marijuana growing operations, but whether the presence of the operations is a significant contributing factor for other crime is unknown. Despite a lack of empirical evidence that grow ops increase criminal activity, it is important to note that police sources (Royal Canadian Mounted Police [RCMP], 2010) insist that marijuana grow ops are a major source of funding for organized criminal groups, many of which use violence to protect their criminal interests.

With organized crime group competing against each other within the drug production industry, it is conceivable and indeed probable that a marijuana growing operation might be the target of a criminal attack. The term 'grow rip' has been used to describe the breaking and entering of a residence which houses a marijuana grow op to either steal or destroy the product of a rival.

These types of often violent home invasions may not be reported to police, as the victims may not wish to admit that they were involved in an illegal growing operation. However, some serious cases have come to the attention of the police and have been reported on in the media. The cases described often involve groups attacking homes that were found to contain marijuana plants (Baker, 2009a; Freeman, 2009; Hooper, 2009; Zytaruk, 2009a,b,c). Common in these accounts was that violence was used against the occupants of the houses, often involving weapons such as firearms and knives. In one case (Zytaruk, 2009a), five intruders mistakenly invaded a home that they thought contained a marijuana growing operation and held two residents captive before leaving. What is alarming is that some organized crime groups have formed with their primary function being to commit home invasions of grow ops. Again, as a result of children living in homes used to grow marijuana, these home invasions can put children in direct harm, and research has indicated that children have suffered injuries and experienced trauma (Douglas, 2010).

In addition to the potential for home invasions and other violence to increase as a result of the drug trade, the presence of marijuana growing operations also offers an avenue for young people to become involved in criminal activity. This is especially true for children who are raised in residences housing grow ops, since they are exposed to a lifestyle that includes illegal activities. Research by Bouchard, Alain, and Nguyen (2009) indicated that in some areas the existence of a marijuana cultivation industry provides the opportunity for youth to make money and become involved in crime. From their sample, Bouchard et al. (2009) reported that 12% of youth between age 13 and 17 in a region in Quebec had participated in the production of marijuana in the previous year. It is certainly a possibility that youth in parts of British Columbia are exposed to opportunities similar to those of the adolescents in the Quebec community studied by Bouchard et al. (2009). Perhaps the allure of easy money, the access to marijuana, and the excitement of the criminal or gang lifestyle among other enticing factors that surround marijuana production could make marijuana cultivation the starting point in the criminal careers of some young people.

The indoor marijuana growing industry has negative effects that permeate into other aspects of society, influencing the lives of even those who may not be seem directly affected. Perhaps most problematic is the fact that, in many places, it may not be a safe assumption that indoor marijuana growing is not occurring nearby. Based on calculations by Bouchard (2007), the risk of detection in one year for indoor marijuana growing operations in Quebec was less than 10%, even for the largest operations. If the large majority of grow ops go on undetected, this implies that there may be many contaminated residences that used to be former growing operations. The stigma of a past marijuana growing operation can greatly reduce the value of a property, and with the relatively low chance of detection, there have likely been a number of sales of former growing operations in the province that have gone undisclosed. In addition to the health and safety hazards associated to any tampering or leftover mould and chemicals, our focus group (Surrey Fire Service focus group, July 10, 2009) reports that the future discovery of those

these legitimate consumers, while negatively impacting communities and the environment. Again, since the industry operates illegally, these problems cannot even begin to be offset through the collection of taxes.

How Can the Potential Yield of a Marijuana Growing Operation be Estimated?

Estimating the potential yield of a marijuana growing operation has historically been very speculative. There are a lot of variables to consider when estimating the potential yield of these operations. Previously, estimates of the annual yield of marijuana growing operations have been predominantly based on the number of plants discovered at the growing site and the number of crops that can be produced in a year. As Bouchard (2008) noted, previous estimates tended to be largely exaggerated because the assumptions about the amount of marketable product per plant were inaccurate. Assuming that each of the marijuana plants in an operation could produce anywhere from 1lb to 1 kg (2.2lbs) greatly over estimates the potential yield of a marijuana grow op. We have determined that even the 100 grams per plant estimate originally used by Plecas, Dandurand, Chin, & Segger, (2002) has now been determined to be an over-estimate.

Although the estimates for the amount of marketable product per plant have historically been overstated, researchers trying to understand illegal marijuana production have generally had a strong understanding of the number of crops that can be produced each year. In his estimates, Easton (2004) used the figure of four crops annually for a 100 plant operation. This reflects the figure used by Bouchard (2008), who suggested that large operations (more than 100 plants) would generally produce four crops, while medium and small operation (20 to 100 plants and 1 to 20 plants respectively) would produce three crops. Outdoor operations of any size were estimated to produce only one crop (Bouchard, 2008). For the remainder of this report, we are going to estimate that a grow op for personal use will produce three crops annually and one intended for profit will produce four crops annually.

Recent research from Toonen, Ribot, & Thissen (2006) reported that the yield per plant was 33.7 grams and that generally 15 plants were grown around a single lamp. These findings reflect the general consensus of growers and other researchers (Bouchard, 2008), and would present a better alternative to other grams per plant estimates. However, as much of the yield depends on the amount of light received by each plant, the yield of 33.7 grams per plant may only be accurate for those grow ops that are configured in a similar way with 15 plants around each lamp. Also, as even the best growers experience plant attrition at some time prior to harvesting the crop (Bouchard, 2008), estimating yield purely based on the number of plants present at a growing site may provide an estimate that is over or under the actual yield. As this is the case, an easier and potentially more accurate way to estimate the yield of a marijuana growing operation is to base the estimate on the number of lights rather than plants.

A grower's 'rule of thumb' that was reported by Bouchard (2008) which also reflects information provided to us by our contact, Brian Carlisle⁸ (personal communication, October 1, 2009), is that the predictable yield for a marijuana growing operation can be approximated at 1 lb per active light each crop. As 1 lb is the equivalent of 454.5 grams, this easy 'rule of thumb' provides an estimate that generally reflects the yield data from the studies of both Toonen et al. (2006) and Bouchard (2008). Recent research by Potter and Ducombe (2011) suggest that on the high end, yields can be predicted at approximately 1.0 grams per watt, and at the low end, 0.75 grams per watt. This would suggest that the 1 lb per light rule would be consistent with the lower end of Potter and Ducombe's (2011) predictions for a 600W light. This would appear to provide a conservative estimate of yield that allows for variations in the output of lights and the number of plants growing under a light. For the remainder of this report, estimates of the potential yield of marijuana growing operations will rely on the assumption that a light produces 454.5 grams each crop. Furthermore, the authors suggest that 1 lb per light estimate would provide an improved standard that can be adopted by criminal justice policy makers, law enforcement officers, crown prosecutors, and judges when dealing with cases of indoor marijuana production.

What is Needed to Set Up and Maintain a Marijuana Growing Operation?

The setting up and maintaining of a marijuana growing operation, especially one intended for commercial viability, has a number of prerequisites, chief among them the ability to fund the operation for a period before profits can be generated. As the start up and maintenance costs are key considerations for determining whether or not an operation of a particular size could be commercially viable, it is important to have an understanding of these costs. To answer this question, we list the required skills and funding for a ten light operation. The estimated costs of a ten light operation can be used to easily extrapolate the costs for operations of any size. The estimates we use here are set to represent a minimum level of expenditure that when extrapolated would take into consideration economies of scale and increasing levels of sophistication.

With the help of our experienced grower contact, Brian Carlisle, we have listed below the equipment and services necessary to set up a commercially viable grow op along with the estimated minimum costs associated to each. We concede that some, even the majority, of commercial operations might spend more on some components or use equipment not listed here, but this list is intended to represent the most basic of commercial operations.

Lights – \$2500: Every indoor grow op requires lights. In the vast majority of cases in British Columbia, these lights used 1000 W bulbs. We estimate a cost of \$250 per light.

⁸ Brian Carlisle is a very knowledgeable source on the topic of marijuana growing. He is a former medical marijuana grower with 15 years of experience dealing with the market for both illegal and medical marijuana

Reflectors - \$80: To increase the amount of light received by the plants, a reflector is used with each light. Each reflector is estimated at a cost of \$80.

Timer - \$200: A timer is used to control when the lights turn on and off. For this scenario, only one timer is used, although some operations may use more timers and use them for a variety of purposes. The timer is estimated at a cost of \$200.

Wiring and Electrical Set Up - \$3000: As residences are not originally intended to house marijuana grow ops, a new growing location will require extensive changes to the electrical system and wiring in order to power the high energy lights. Although there are many cases in which the electrical systems in grow ops are improperly installed, we assume that someone with the skills and training, or at least the experience of an electrician would be required to ensure the grow op could function. To account for the costs of the wiring, electrical panels, and the electrician's labour, we conservatively estimate the setup cost for the ten-light operation at \$3000.

Retrofitting Growing Environment - \$2000: In order to make the environment suitable for growing, structural changes need to be made to the grow room. The estimate of \$2000 includes both supplies and the labour charges of a carpenter or handyman.

Fans - \$200: In order to keep the necessary air flow within the grow room, fans are needed. The air movement can also strengthen the plants, allowing them to better support the growth of buds. We estimate two oscillating fans for the grow room at \$100 each.

Cooling Unit - \$1000: The high energy lights can raise the temperature of a grow room to levels that can jeopardize the plants. In order to keep the temperature at a suitable level, some type of cooling unit is required. We conservatively estimate that a low quality cooling unit (e.g. either a chiller, air conditioner, or heat exchanger) would be an expense of \$1000.

Dehumidifier - \$100: To reduce the humidity of the growing environment, the operation would require at least one dehumidifier. We estimate the low range cost of a dehumidifier at \$100.

Ventilation - \$500: Outside air is required to keep the plants healthy, and consequently the indoor air needs to be displaced. By converting existing ventilation or creating new outlets for the grow op, we conservatively estimate the costs of venting at \$500.

Charcoal Filter - \$100: To avoid the smell of growing marijuana escaping through the ventilation port, a charcoal filter would need to be installed. We estimate a charcoal filter for one outward vent at \$100.

CO₂ - \$200: Carbon dioxide is widely used to improve the growing condition. A machine for increasing the carbon dioxide levels in the grow room is estimated at \$200.

Pots - \$200: With 15 plants around each light, the ten-light operation would require 150 pots in which to grow the plants. We estimate the cost for three 5 gallon pots at \$4.00.

Soil - \$300: With approximately 15 plants around each light, a ten light operation would require soil for about 150 plants. Although not all growing techniques require soil, for the purpose of this estimation we assume a soil-based operation. With each plant in a 5 gallon pot, we estimate that a 50 gallon bag of growing soil would cost \$20, creating an expense of \$300 for the necessary 15 bags.

Herbicides & Pesticides - \$150: To protect the crop from potentially harmful pests, a supply of chemicals would likely be on site to be administered in the case of infestation. Based on the information from our focus group on the hazards of marijuana growing operations and the research of Blair and Wedman (2009), we know that the use of herbicide and pesticides in growing operations is not uncommon. We estimate the cost the necessary amount of chemicals for a ten light operation to be \$150.

Clones - \$750: The marijuana plants intended to be grown and harvested have to come from somewhere. Although the plants can be grown from seeds, it is most likely that commercial growing starts with clone plants purchased from another illicit source. We estimate that a tray of 50 clones would cost \$250. The expense incurred from three trays is \$750. We include this as a setup cost because we assume that additional clones can be taken from a mother plant from the first crop, but we acknowledge that some operations may choose to buy new plants for each crop.

The accumulation of all of the previously listed expenses adds up to a setup cost of \$12,000 for the ten-light operation. In addition to these initial costs, a marijuana growing operation can incur considerable ongoing expenses. These include the rent or mortgage payments for the location, the electricity to run the growing lights and equipment, the nutrients for the plants, and additional bulbs and other supplies. Ongoing costs can be greatly reduced if the grow operator steals electricity or generates it onsite. Also, for those growers who do not have to rent or buy an additional property specifically for the purpose of marijuana production, the costs associated to the grow op are again reduced. However, we still estimate that ongoing costs for the supplies necessary to maintain a ten-light operation at around \$1000 per crop.

What is a Commercially Viable Marijuana Growing Operation?

Marijuana production can be a lucrative illegal endeavour, but not all cases of marijuana cultivation are intended to turn a profit. Smaller operations intended for personal use are illegal and are still a concern, but those operations that are intended for large profits present greater risks and are a main source for the illicit drug trade. Therefore, it is important to have the ability to distinguish between those marijuana growing operations that are for personal use and those that are designed specifically to be commercially viable.

The concept of commercial viability in the marijuana production business is likely something that has changed over time. As innovative detection techniques are developed and used by law enforcement, a grower's need for security and counter-detection strategies increase. What was

required for a profitable marijuana growing operation in the late 1990s or early 2000s have no doubt changed somewhat from what is currently necessary in order to compete in the illegal market. The changing reality increases the costs of doing business and thus may force some growers out of the market, leaving marijuana production an industry predominated by high quantity producers who are very sophisticated and extremely competitive.

However, the marijuana growing operations that are intended for personal use may not differ from those that have existed historically. Since grow ops for personal use are separated from the larger illegal production and distribution industry and the chance of detection is generally much lower for small size operations (Bouchard, 2007), it is likely that the factors that may be forcing small and mid-sized commercial operations out of business would have little to no affect. If this is an accurate representation of current progression in the illegal marijuana production industry, it should become increasingly easier to distinguish between those operations that are commercially viable and those that are mainly for personal use.

In the meantime, however, to determine whether a grow op is or was intended for profit, it is important to explore two main factors. The first is how much marijuana is needed for personal use. If a grower is only growing enough for his or her own consumption, the number of plants and lights used in the operation should reflect that purpose. According to data from the 1991 National Household Survey on Drug Abuse (Gfroerer, Gustin, Virag, Folsom, & Rachel, 1991), the average marijuana user consumes the drug at a rate of 281 joints per year. A joint ranges between 0.5 and 1 gram⁹ (Easton, 2004); therefore, the consumption for an average user would be between 11 - 23 grams per month, or 140.5 - 281 grams per year. Health Canada (2010) recognizes that most users of medical marijuana will consume 1 to 3 grams of dried marijuana per day. Consumption at the upper range for these users would require a supply of 1.095 kilograms per year.

From the previous discussion of the yield of marijuana growing operations, it was concluded that a grower will generally produce 1lb or 454.5 grams per light for each crop harvested. Assuming that the grow op for personal use produces three crops annually, a one-light operation might yield 3 lbs (1.3635 kg) of dry marijuana each year. That roughly translates to the amount of marijuana used by those medical users in the upper range of Health Canada's (2010) figure for a period of 15 months. It is almost ten times more marijuana than the 140.5 grams smoked by the average user.

Given that the potential yield of a one light operation would be more than ten times what an average marijuana users might consume in a year, it would be fair to suggest that an operation consisting of more than one light has the potential produce more than what is needed for the

⁹ In general, the average marijuana smoker would likely smoke a half gram joint, while more frequent or 'chronic' users might larger joints of one gram. For the purpose of estimations later in this report, we assume the average joint to weigh 0.5 grams.

average user. However, given that dried marijuana may not have a shelf life that lasts the period between each crop, it could be argued that an operation intended only for personal use may use four lights, each used to grow a crop that can be harvested at a different time. After operating for four months, the potential yield would still be around 12 lbs (5.454 kg) annually, but could produce a fresh 1 lb harvest each month. This potential annual production translates to more than 30 half-gram joints per day, nearly five times the yearly consumption of the medical user and nearly 40 times that of the average users.

Of course, the 1 lb per light approximation might be better suited for estimating the potential production of larger operations that are intended to make profit. It is possible that a grower with a few-light operation is not trying to produce to the 'rule of thumb'. This might be a necessary consideration that factors into the discretion of whoever needs to assess whether the operation is indeed intended for personal use. However, the fact still remains that the potential yield of the grow op is around the range of 1 lb per light or higher regardless of the grower's current skill or intentions. In conclusion, a very inclusive criterion for grow ops intended for personal use might be an operation with four or fewer lights.

The second factor in whether a marijuana growing operation is commercially viable is whether or not the potential for profit is larger than the costs incurred through set up and maintenance. Easton (2004) estimated the costs of running a 100 plant marijuana growing operation at approximately \$24,500, and earning around \$76,000. Easton assumes a 50 / 50 split of the revenue between an investor and an operator, suggesting that the investor nets \$13,600 over the year. His calculations demonstrate how even with such a business arrangement, a 100 plant operation was commercially viable in 2000.

For our own analysis we estimate that a grower can sell 1 lb of harvested marijuana for \$1800¹⁰. Table 1 incorporates the estimated costs of setting up and maintaining marijuana growing operations to estimate the potential for profits for grow ops of various sizes. The estimated setup costs were extrapolated from the previously concluded cost of \$12,000 for a ten-light operation to an estimated \$1,200 per light. Inherent in these estimations is the recognition that quantities of scale would naturally reduce the costs per light for larger operations, but at the same time, with increased size comes a necessity for greater sophistication, and therefore the increased costs associated to greater sophistication may balance out the potential savings. Although we concede that the costs are a conservative estimate, Table 1 demonstrates that if a grower steals electricity and does not have to pay for an added rent or mortgage to house the grow, even a one-light operation has the potential to make some profit. Although a 50 /50 split between an investor and operator was assumed by Easton (2004), this table offers only the overall profit of the operation

¹⁰ \$1800 per lb is consistent with the authors' information from police sources and even lower than the \$2000 per pound used in the earlier edition (Plecas, Diplock, & Garis, 2009) and the \$2600 per pound used by Easton (2004) based on prices in 2000.

as a whole. Furthermore, the table does not take into account other costs such as those incurred for extra labour, counter detection, or security, which may be a pivotal expense for those operations that can continue successfully over time.

It was apparent in the research by Plecas et al. (2005) that marijuana growing operations in British Columbia became larger and increasingly more sophisticated from 1997 to 2003. By 2003, more than half of marijuana growing operations had more than 100 plants and the average number of lights used for a grow op was 15.5. While the 100 plant grow op discussed by Easton (2004) may have been the standard for commercial viability for the early years of the 2000s, by 2010 and now into 2012, we expect the majority of commercial grow ops to be much larger. In their research on founded grow ops in two areas in British Columbia, Chaisson and Plecas (2011a; 2011b) found the average number of lights to be 27.5. For those operations that stole electricity, the average was 36 lights.

Table 1 demonstrates that marijuana growing operations of any size can make a profit under the right conditions, and large ones can be very lucrative. This is especially true when the operation involves stealing electricity or generating it onsite. Of course, the risks associated to growing marijuana, the extent of a grower's black market connections, and the potential for added expenses are all further considerations necessary to assess whether an operation of a specific size does manage to profit. However, when deciding upon whether a grow op should indeed be considered "commercial", the intent to make profit may be more important than whether or not the grower has the skills and market conditions to make profit. It should also be emphasized that the value of the profits is considerably higher when one considers that it is accumulated tax free. Therefore, despite the uncertainty with regard a definitive answer on what represents a commercially viable grow op, it is likely that majority of growing operations with more than 4 lights are intended for more than the personal use of a single person. Also, what can be concluded more concretely is that even for very large operations, the setup costs are such that it is highly unlikely that an operation would ever be intended for only a single crop, and therefore, the potential for profit should be estimated beyond the production of the single crop that exists at the time an operation is discovered.

How Many Marijuana Growing Operations are in British Columbia?

Presently, the number of marijuana growing operations in British Columbia cannot be known with any great certainty. The extent of marijuana production in the province must be estimated based on the information from available sources. Police information on the number of marijuana growing operations attended and dismantled is the most common source from which to base estimations of the true number of operations in the province. However, in recent years, some communities around the province have implemented non-traditional enforcement responses, namely Electrical and Fire Safety Inspection Initiatives (EFSI), to actively deal with some cases

of suspected marihuana growing operations (Garis, 2008; Ginn, 2007). Information from these HFST teams presents an additional source for estimations of the extent of marihuana production.

Using the data from Plecas et al. (2002) on the number of marihuana growing operations discovered by police in 2000, Easton (2004) estimated the number of active grow ops in that year to be approximately 17,500¹¹. Bouchard (2007) proposed a method of estimating the actual size of the marihuana cultivation industry called a capture-recapture model. He estimated the annual number of marihuana growing operations in the province of Quebec to be approximately 13,000 for the years 2000 and 2001. In a previous edition of this report (Plecas et al., 2009), the authors produced estimates for the number of active marihuana growing operations in British Columbia using available data from 2003 (originally presented by Plecas et al., 2005). These estimates used variations of the estimation techniques used by Easton (2004) and Bouchard (2007), and without current data, the final estimate settled upon was intentionally conservative, concluding that at least 10,000 marihuana growing operations were producing the illicit drug at the time of the article. This number was less than, but not substantially different from estimates that arose from the adaptation of methods originally described by Easton (2004) and Bouchard (2007). With more recent police data from 2010, it is possible to provide a more accurate and up to date approximation of the number of growing operations operating in the province.

Information from police data indicates that there were 2,348 founded cases of marihuana production in British Columbia in 2010¹². Of these cases, approximately 90 percent were indoor operations: a total of 2,113 founded indoor grows. Without a range of detailed data on the offenders associated to these founded grows, using Bouchard's (2007) capture-recapture model will not be possible. However, since the estimate produced from Bouchard's model was very similar to that arising from the use of Easton's (2004) model¹³, Easton's economic model alone will be used to provide one of the alternative estimates of the number of marihuana growing operations in British Columbia for this edition of the report. Based on an analysis of the costs and potential profit of operating a marihuana growing operation, the previous edition of this report (Plecas et al., 2009) concluded that the value to cost ratio (1.5) used by Easton (2004) was consistent with their findings of an average of 1.41. However, factors relating to the profitability of growing operations have changed with more recent data. The average number of lights used in

¹¹ Easton (2004) estimated the number of marihuana growing operation using the formula $T = B[1+PQ/C]/[(PQ/C)-(1+R^*)]$, where T is the total number of growing operations, PQ/C is a ratio of value to cost = 1.5, R* is the assumed return to legal activities, and B is number of founded marihuana growing operations discovered by police during the year.

¹² A one page summary data sheet on marihuana growing operations in British Columbia (2004-2010) was provided to the authors by 'E' Division Operations Strategy Branch.

¹³ In Plecas et al. (2009), the use of Bouchard's model yielded an estimate of 11,500 total growing operations, while Easton's model produced an estimate of 12,500.

growing operations across British Columbia increased from 15.5 in 2003 (Plecas et al., 2005) to about 27.5 in 2010 (Chaisson & Plecas, 2011a; Chaisson & Plecas, 2011b), the wholesale price of marihuana has decreased, and the costs of hydro electricity has increased. The value to cost ratio extrapolated from the data in Table 1, suggests that an average 27.5 light operation would have a value to cost ratio of 1.37, which is lower than the 1.41 reported in the earlier edition (Plecas et al., 2009). Changing only the number of founded indoor growing operations, Easton's method produces an estimated total of 13,206²⁴ active grow ops in British Columbia in 2010. However, if we use the value to cost ratio of 1.37 rather than 1.5, Easton's method produces an estimated total of 18,547 active operations, more than 5,000 more operations across the province. For the purpose of this paper, we will use the conservative estimate of 13,206 marihuana growing operations in the province in 2010, which is consistent with information provided to the authors from BC Hydro for a previous report (Diplock & Plecas, 2011).

How Much Marihuana is Produced by British Columbia's Commercially Viable Marihuana Growing Operations?

Estimating the entire marihuana production in British Columbia requires the answers to many of the previously discussed questions. It requires an ability to estimate the yield of a marihuana growing operation, knowledge of size of operations, and a figure to represent the total number of active operations contributing to the market. Using his estimates of the marihuana industry in 2000, Easton (2004) determined that British Columbia produced approximately 416,000 kg (915,200 lbs) of marihuana per year.

To provide a more current estimate of British Columbia's annual commercial marihuana production, we will apply the figures concluded upon previously. Based on data from marihuana growing operations discovered by police in some regions in British Columbia, the average size of an indoor operation in British Columbia was 27.5 lights (Plecas & Chaisson, 2011a; Plecas & Chaisson, 2011b). Given a yield of 1lb per light for each crop and a total of four crops in the year, the average growing operation produced 110 lbs (50 kg) over the year. With a population of 13,206 active commercial grow ops within the province, we can conclude that a total of 1,452,660 lbs of commercial marihuana was produced during the year.

²⁴ Easton (2004) estimated the number of marihuana growing operation using the formula $T = B[1+PQ/C]/[(PQ/C)-(1+R^*)]$, where T is the total number of growing operations, PQ/C is a ratio of value to cost = 1.5, R* = .10 is the assumed return to legal activities, and B is number of founded marihuana growing operations discovered by police during the year.

Where Does the Produced Marihuana Go?

Based on the previous calculations, we can assume that at least 1,452,660 lbs of commercial marihuana is produced annually. Depending on the size of the domestic demand for the drug in British Columbia, a certain portion of the illegal product is exported to other provinces and other countries. According to the RCMP's (2010) Report on the Illicit Drug Situation in Canada for 2009, marihuana produced in British Columbia travels east into Alberta, south into the United States, and likely elsewhere to other foreign markets. The amount of marihuana produced exceeds domestic consumption, suggesting much of the product is cultivated specifically for export (RCMP, 2010). The exportation of marihuana out of British Columbia and into the United States is of great concern to authorities on both sides of the border, and while it is known that much of British Columbia's marihuana is intended for markets in the United States, the extent of exporting of British Columbia's marihuana into the United States is unknown.

Using our previous estimate of 1,452,660 lbs of commercial marihuana produced annually, we can estimate the amount of marihuana that leaves British Columbia bound for other parts of Canada and the United States. Figures from Health Canada (2011) indicated that about 12.6% of British Columbians aged 15 and older had used marihuana in 2010. Given that BC Stats (2012) estimated there were 3,843,137 British Columbian age 15 and older, we can approximate the number of marihuana users in the province at 484,235. Due to the fact that marihuana users vary greatly in their methods of use, consumptions, and likelihood of sharing with others, estimating the quantity of marihuana used by the average user is a major challenge (Gray, Watson, & Christie, 2009). Therefore, without strong current estimates of consumption for the average British Columbian marihuana user, this report is relying on the previously mentioned 281 joints per year to represent usage (Gfroerer et al., 1991). If the average user smokes joints weighing 0.5 grams, British Columbia's domestic consumption in 2010 was approximately 68,035kg (149,677 lbs). Assuming the province's annual production in 2010 was 1,452,660 lbs, the domestic consumption represents only about 10% of the total commercial product. This is a considerable change from our previous estimates which relied primarily on production information from 2003 (Plecas et al., 2009). With the increased production capacity grow ops, the higher overall estimate of active operations, and the reduction in domestic use, it appears that approximately 90% of British Columbia's marihuana is destined for export. As our estimate of commercially produced marihuana does not take into account those operations intended for personal use, it is probable that the domestic consumption of commercially produced marihuana is even less than the estimate provided here. In conclusion, a substantial amount of British Columbia's commercially produced marihuana leaves the provincial borders, suggesting that our local problems with marihuana growing operations have a considerable impact on the drug situations in other jurisdictions.

Table 1: Estimated Potential Profits of Marijuana Growing Operations of Various Sizes

Lights	Furn. / Crop	Set up Cost	Ongoing Expenses			Profit After 1 Crop				Profit After 1 Year			
			Supplies / Crop	Hydro* / Crop	Rent** / Crop	Paying Hydro & Rent	Shedding Hydro	No Rent	Shedding Hydro & No Rent	Paying Hydro & Rent	Shedding Hydro	No Rent	Shedding Hydro & No Rent
1	\$1,800	\$1,200	\$100	\$128.39	\$2,400	-\$2,028.39	-\$1,900.00	\$372	\$500	-\$4,513.38	-\$4,000.00	\$5,066.42	\$5,600
2	\$2,000	\$6,000	\$500	\$241.97	\$2,400	-\$3,411.97	\$100.00	\$1,258	\$2,500	-\$15,832.12	-\$10,400.00	\$21,432.12	\$26,000
10	\$18,000	\$12,000	\$1,000	\$1,283.94	\$3,600	-\$116.06	\$1,400.00	\$3,716	\$5,000	-\$36,464.24	-\$41,800.00	\$50,864.24	\$56,000
25	\$27,000	\$18,000	\$1,500	\$1,927.91	\$3,600	\$1,974.09	\$3,900.00	\$3,574	\$7,500	-\$61,896.36	-\$69,600.00	\$76,296.36	\$84,000
50	\$90,000	\$60,000	\$5,000	\$6,419.70	\$3,600	\$14,980.30	\$21,400.00	\$18,580	\$25,000	-\$139,921.20	-\$265,600.00	\$254,321.20	\$280,000
100	\$180,000	\$120,000	\$10,000	\$12,839.40	\$4,800	\$32,360.60	\$45,200.00	\$37,161	\$50,000	-\$489,442.40	-\$540,800.00	\$508,642.40	\$560,000
250	\$450,000	\$300,000	\$25,000	\$32,098.50	\$12,000	\$80,901.50	\$113,000.00	\$92,902	\$123,000	-\$1,223,606.00	-\$1,352,000.00	\$1,271,606.00	\$1,400,000
500	\$900,000	\$600,000	\$50,000	\$64,197.00	\$24,000	\$161,803.00	\$226,000.00	\$185,803	\$250,000	-\$2,447,232.00	-\$2,704,000.00	\$2,543,232.00	\$2,800,000
1000	\$1,800,000	\$1,200,000	\$100,000	\$128,394.00	\$48,000	\$323,606.00	\$452,000.00	\$371,606	\$500,000	-\$4,894,424.00	-\$5,408,000.00	\$5,086,424.00	\$5,600,000

* The price of hydro electricity was estimated using BC Hydro's stepped rate of \$0.1019 per kWh multiplied by an average of 14kWh per light per day over a 90 day crop.

** Rent was estimated to conservatively reflect the price for required space, assuming each light required at least 25 ft². For five or fewer lights, the estimate assumes at least a two bedroom apartment for \$800 monthly. Between 10 and 50 lights assumes an average house with around 1,800 ft², costing \$1,200 monthly. For 100 lights and larger, the figure of \$185/ft² was used to determine the cost of a house large enough for the operation. The rent for these operations was calculated assuming an added 5% and monthly payments over 25 year.

What is the Value of British Columbia's Marihuana?

The revenue generated by British Columbia's commercial marihuana production industry is approximately \$2.61 billion. Inherent in this figure is the assumption that the marihuana is sold by the pound at \$1800/lb. We present this figure as a conservative estimate of the amount of money that British Columbia's marihuana growers generate from the sale of their product. However, we recognize that when the activities of the broader marihuana market are taken into consideration, the \$2.6 billion figure increases substantially.

The price of British Columbia's marihuana varies depending on where it is sold and in what quantity. The potential retail value of British Columbia's marihuana sold on the street by the joint would be much greater than \$2.6 billion. Furthermore, with the risks of trading marihuana across national borders, it can be expected that the price of British Columbia's marihuana will be inflated somewhat in the United States. The Office of National Drug Control Policy (Spies, 2003) reported that in the early years of the twenty-first century, 'BC bud' could be sold in some American metropolitan areas for as high as \$5000 – \$8000 USD per pound. If all of the 90% of British Columbia's commercially produced marihuana that leaves the province was sold in the United States for at least \$3000 CAD¹⁵, exporters would be earning approximately \$3.9 billion. If we add the wholesale revenue from exported marihuana with the 10% sold domestically for \$1800 per pound, the total value of the entire wholesale market for British Columbia's marihuana is close to \$4.2 billion. When one considers that outdoor growing operations, though more susceptible to eradication from law enforcement and having a more limited growing window, are also contributing extensively to the marihuana production industry in some parts of British Columbia (Kalacka & Bouchard, 2011), the total value of all commercial marihuana produced in the province is likely even higher.

Summary

No doubt, at least for the short term, it will be difficult to get as specific as we might like in trying to describe the nature and extent of marihuana grow operations in British Columbia. Like so many other kinds of crime, and especially those involving organized crime, the size of the dark figure can assumed to be large, and the nature of the activity is ever-changing. Grow ops are becoming increasingly sophisticated and it is clear that those involved are changing their ways of doing business to grow more efficiently, produce more powerful strains, increase profitability, and avoid detection. Still, at this point, it is clear that given the cost to set up an initial grow it is not reasonable that any of those involving more than four lights are "one off" operations. Rather, they are harmful operations intended to generate on-going tax free profits for those who own

¹⁵ To be conservative we estimated that a pound of marihuana could be sold for the equivalent of \$3000 CAD in the United States. This number is consistent with source within the Royal Canadian Mounted Police.

them. Collectively across the province of British Columbia commercial marihuana growers take money out of the pockets of every taxpayer and worse and increasingly so, facilitate the ability of organized crime to become richer, stronger, and more pervasive. We emphasize since in making our calculations and estimates here, we have tried to be deliberately conservative at each step of the assessment. We present what can be viewed as the lower limit of what is a very large problem in British Columbia and elsewhere. We would expect the law enforcement and public safety officials who are close to the problem on a daily basis could give reason to be much less conservative.

References

- Aldington, S., Williams, M., Nowitz, M., Weatherall, M., Pritchard, A., McNaughton, A., Robinson, G., & Beasley, R. (2007). Effects of cannabis on pulmonary structure, function and symptoms. *Thorax*, *62*, 1058 – 1063.
- Aldington, S., Harwood, M., Cox, B., Weatherall, M., Beckert, L., Hansell, A., et al. (2008b). Cannabis use and risk of lung cancer: a case-control study. *European Respiratory Journal*, *31*(2), 280-286.
- Arendt, M., Rosenberg, R., Foldager, L., Ferto, G., & Munk-Jorgensen, P. (2005). Cannabis-induce psychosis and subsequent schizophrenia-spectrum disorders: Follow-up study of 535 incident cases. *British Journal of Psychiatry*, *187*, 510 – 515.
- Aryana, A., & Williams, M. A. (2007). Marijuana as a trigger for cardiovascular events: Speculation or scientific certainty? *International Journal of Cardiology*, *118*, 141 – 144.
- Bedard, M., Dubois, S., & Weaver, B. (2007). The impact of cannabis on driving. *Canadian Journal of Public Health*, *98*(1), 6 – 11.
- Baker, R. (2009a). Man shot at suspected grow-rip. *The News*. Retrieved August 18, 2009 from Canadian Newsstand.
- Bari, M., Battista, N., Pirazzi, V., & Maccarrone, M. (2011). The manifold actions of endocannabinoids on female and male reproductive events. *Frontiers in Bioscience*, *16*, 498-516.
- BC Hydro. (2010). *Clean power call requests for proposals: Report on the RFP process*. Retrieved April 16, 2011 from http://www.bchydro.com/planning_regulatory/acquiring_power/clean_power_call.html.
- BC Stats. (2012). *Population estimates, British Columbia and Sub-Provincial*. Available from <http://www.bcstats.gov.bc.ca/StatisticsBySubject/Demography/PopulationEstimates.aspx>.

- Berthiller, J., Straif, K., Boniol, M., Voirin, N., Benhaim-Luzon, V., Ben Ayoub, W., et al. (2008). Cannabis smoking and risk of lung cancer in men: a pooled analysis of three studies in Maghreb. *Journal of Thoracic Oncology*, 3(12), 1398-1403.
- Beshay, M., Kaiser, H., Neidhart, D., Reymond, M.A., & Schmid, R.A. (2007). Emphysema and secondary pneumothorax in young adults smoking cannabis. *European Journal of Cardio-Thoracic Surgery*, 32, 834-838.
- Blair, J. & Wedman, G. (2009). *Residual pesticides in former marijuana grow-operations: Determining safe levels*. Available from http://www.pacificenvironmentalbc.com/newsletters/PacificEnvironmental1_files/AIHce%202009%20Poster.pdf
- Bouchard, M. (2007). A capture-recapture model to estimate the size of criminal populations and the risks of detection in a marijuana cultivation industry. *Journal of Quantitative Criminology*, 23, 221-241.
- Bouchard, M. (2008). Towards a realistic method to estimate cannabis production in industrialized countries. *Contemporary Drug Problems*, 35, 291-320.
- Bouchard, M., Alain, M., & Nguyen, H. (2009). Convenient labour: The prevalence and nature of youth involvement in the cannabis cultivation industry. *International Journal of Drug Policy*, 20(6), 467-474.
- British Columbia. Office of the Premier. (2011, May 9). *Premier Christy Clark announces free support to help smokers*. Retrieved April 29, 2012 from http://www2.news.gov.bc.ca/news_releases_2009-2013/2011PREM0049-000518.htm
- CBC News. (2009, September 2). Realtors develop grow-op remediation standards. *CBC News Online*. Retrieved June 3, 2012 from <http://www.cbc.ca/news/canada/calgary/story/2009/09/02/calgary-pothouse-remediation.html>
- Cho, C. M., Hirsch, R., & Johnstone, S. (2005). General and oral implications of cannabis use. *Australian Dental Journal*, 50(2), 70 – 74.
- Chaisson, K., & Plecas, D. (2011a). *The Nature and Extent of Marijuana Growing Operations in Mission, British Columbia: A 14 Year Review (1997-2010)*. Abbotsford, BC: University of the Fraser Valley.
- Chaisson, K., & Plecas, D. (2011b). *The Nature and Extent of Marijuana Growing Operations in the Cariboo Region of British Columbia: A 14 Year Review (1997-2010)*. Abbotsford, BC: University of the Fraser Valley.
- Daling, J.R., Doody, D.R., Sun, X., Trabert, B.L., Weiss, N.S., Chen, C., et al. (2009). Association of marijuana use and the incidence of testicular germ cell tumors. *Cancer*, 115(6) 1215-1223.

- Degenhardt, L., & Hall, W. (2006). Is cannabis use a contributory cause of psychosis? *Canadian Journal of Psychiatry*, 51, 556 – 565.
- Diplock, J., Plecas, D., and Garis, L. (2012). An updated review of the research on the risks and harms associated to the use of marijuana. *The Journal of Global Drug Policy and Practice*. Available from <http://www.globaldrugpolicy.org>
- Diplock, J., & Plecas, D. (2011). *The increasing problem of electrical consumption in indoor marijuana grow operations in British Columbia*. Abbotsford, BC: University of the Fraser Valley.
- Douglas, J. (2010). *The health and safety of children living in marijuana grow operations: A child welfare perspective*. Unpublished doctoral thesis, University of British Columbia, Vancouver, BC, Canada.
- D'Souza, D.C., Sewell, R.A., Raganathan, M. (2009). Cannabis and psychosis/ schizophrenia: human studies. *European Archives of Psychiatry and Clinical Neuroscience*, 259(7), 413-431.
- Easton, S. T. (2004). *Marijuana Growth in British Columbia*. Fraser Institute. Retrieved April 2, 2006, from <http://www.fraserinstitute.ca/admin/books/files/Marijuana.pdf>
- El Marroun, H., Tiemeier, H., Steegers, E.A.P., Jaddoe, V.W.V., Hofman, A., Verhulst, F.C., et al. (2009). Intrauterine cannabis exposure affects fetal growth trajectories: the Generation R study. *Journal of the American Academy of Child and Adolescent Psychiatry*, 48(12), 1173-1181.
- Fergusson, D.M. & Boden, J.M. (2008). Cannabis use and later life outcomes. *Addiction*, 103(6), 969-976.
- Fergusson, D. M., Boden, J. M., & Horwood, J. L. (2006). Cannabis use and other illicit drug use: Testing the cannabis gateway hypothesis. *Addiction*, 101, 556 – 569.
- Finn, K.V. (2012). Marijuana use at school and achievement-linked behaviors. *High School Journal*, 95(3)3-13.
- Freeman, R. (2009). Chilliwack man shot, stabbed in home invasion. *The Chilliwack Progress*. Retrieved August 18, 2009 from Canadian Newsstand.
- Garis, L. (2008). *Eliminating residential hazards associated with marijuana grow operations and the regulation of hydroponics equipment: A brief on, British Columbia's Public Safety Electrical Fire and Safety Initiative*. Available from <http://www.nlafcff.nf.ca/pdf/ECABC%20Brief%20on%20BC's%20Public%20Safety%20Electrical%20Fire%20Safety%20Initiative.doc.pdf>

- Gill, A. (2005). Bong lung: Regular smokers of cannabis show relatively distinctive histologic changes that predispose to pneumothorax. *The American Journal of Surgical Pathology*, 29, 980-981.
- Gim, P. (2007). *An alternative response model to marijuana grow operations: The electrical fire and safety investigation initiative as a case study*. Abbotsford, BC: University of the Fraser Valley.
- Gfroerer, J., Gustin, J., Virag, T., Folsom, R. & Rachal, J. (1991). MDA Data Set No. 05-06: The 1991 National Household Survey on Drug Abuse. SAMHSA
- Gray, K.M., Watson, N.L., & Christie, D.K. (2009). Challenges in quantifying marijuana use. *The American Journal on Addictions*, 18, 178-179.
- Gustin, B. (2010, June). The hazards of grow houses. *Fire Engineering*, 163 (6), 69-71.
- Hall, W. D. (2006). Cannabis use and the mental health of young people. *Australian and New Zealand Journal of Psychiatry*, 40, 106 – 119.
- Hasin, D.S., Keyes, K.M., Alderson, D., Wang, S., Aharonovich, E., & Grant, B.F. (2008). Cannabis withdrawal in the United States: a general population study. *Journal of Clinical Psychiatry*, 69(9), 1354-1363.
- Hayatbakhsh, M.R., Flenady, V.J., Gibbons, K.S., Kingsbury, A.M., Hurrion, E., Mamun, A.A., et al. (2012). Birth outcomes associated with cannabis use before and during pregnancy. *Pediatric Research*, 71(2), 215-219.
- Hii, S., Tam, J.D.C., Thompson, B.R., & Naughton, M.T. (2003). Bullous lung disease due to marijuana. *Respirology*, 13, 122-127.
- Health Canada. (2011). *Canadian Alcohol and Drug Use Monitoring Survey: Tables – 2010*. Retrieved April 29, 2012 from http://www.hc-sc.gc.ca/hc-ps/drugs-drogues/stat/_2010/tables-tableaux-eng.php#t2.
- Health Canada. (2010). *Medical marijuana monograph – Information for health care professionals*. Ottawa, ON: Author.
- Holmes, M. (2010, January 9). A cautionary tale, there are savings, but buying a former grow-op comes with. *The Ottawa Citizen*. Retrieved June 3, 2012 from Canadian Newsstand.
- Hooper, R. (2009). Grow-op heist nets fugitive; Police investigating a property damage complaint arrested a man wanted on charges in the U.S. *Langley Advance*. Retrieved August 18, 2009 from Canadian Newsstand.
- Johnson, L.J., & Miller, J.D. (2011). Consequences of large-scale production of marijuana in residential buildings. *Indoor and Built Environment*. DOI. 10.1177/1420326X22522954.

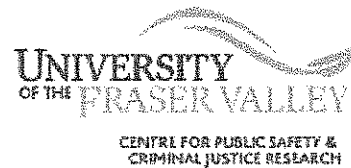
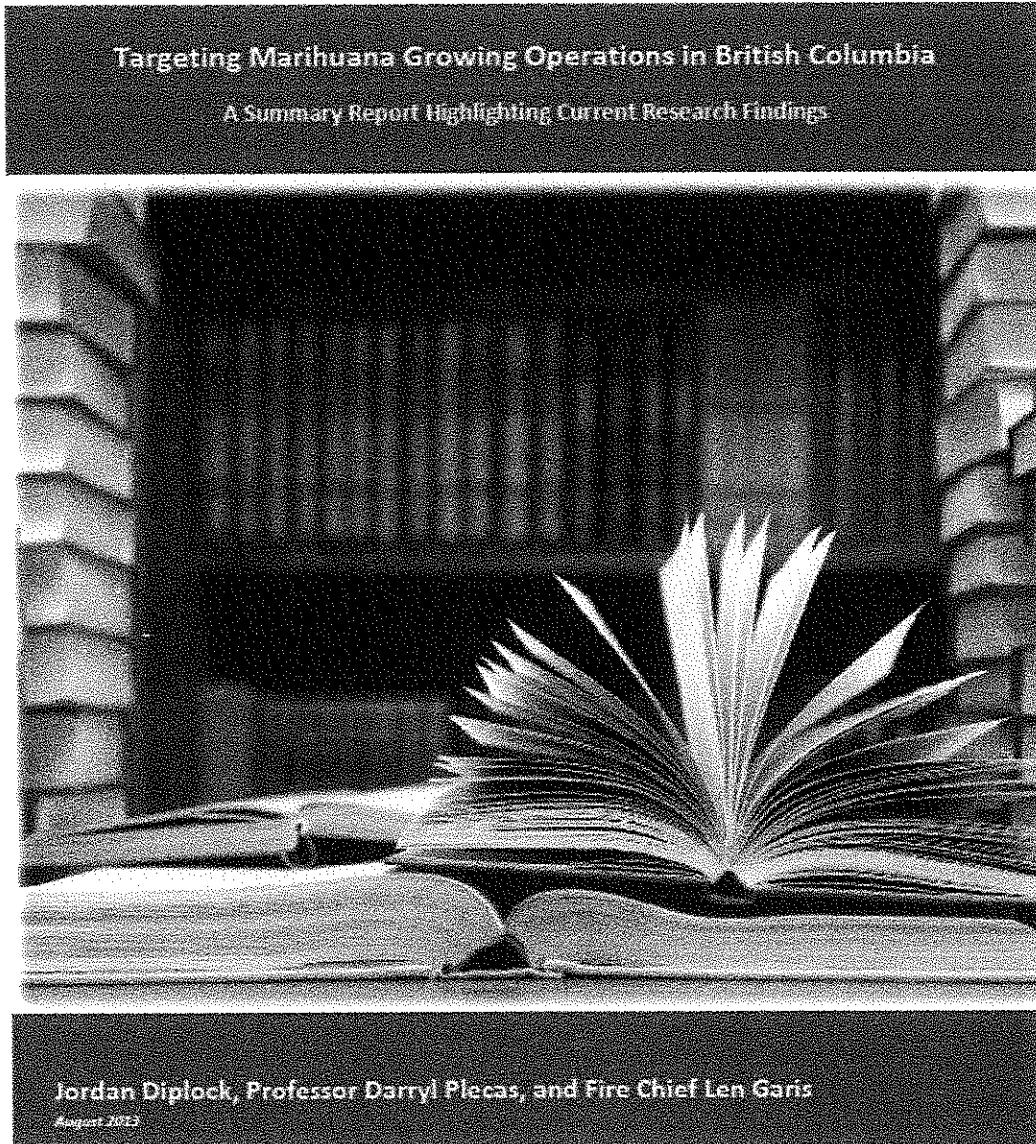
- Kalacska, M., & Bouchard, M. (2011). Using police seizure data and hyperspectral imagery to estimate the size of an outdoor cannabis industry. *Police Practice and Research: An International Journal*, 12(5), 424-434.
- Lindsay, A. C., Foale, R. A., Warren, O., & Henry, J. A. (2005). Cannabis as a precipitant of cardiovascular emergencies. *International Journal of Cardiology*, 104, 230 – 232.
- Looby, A., & Earleywine, M. (2007). Negative consequences associated with dependence in daily cannabis users. *Substance Abuse Treatment, Prevention, and Policy*, 2(3). Retrieved November 21, 2007 from <http://www.substanceabusepolicy.com/content/2/1/3>
- Lynskey, M. & Hall, W. (2000). The effects of adolescent cannabis use on educational attainment: A review. *Addiction*, 95, 1621- 1630.
- Lynskey, M. T., Vink, J. M., & Boomsma, D. I. (2006). Early onset use and progression to other drug use in a sample of Dutch twins. *Behavioral Genetics*, 36, 195 – 200.
- Malone, D.T., Hill, M.N., & Rubino, T. (2010). Adolescent cannabis use and psychosis: epidemiology and neurodevelopmental models. *British Journal of Pharmacology*, 160, 511-522.
- McLaren, J.A., Silins, E., Hutchinson, D., Mattick, R.P., & Hall, W. (2010) Assessing evidence for a causal link between cannabis and psychosis: a review of cohort studies. *International Journal of Drug Policy*, 21(1), 10-19.
- Mehra, R., Moore, B. A., Crothers, K., Tetrault, J., & Fiellin, D. A. (2006). The association between marijuana smoking and lung cancer: A systematic review. *Archives of Internal Medicine*, 166, 1359 – 1367.
- Moller, M., Koren, G., Karaskov, T., Garcia-Bourmissen, F. (2011). Examining the health and drug exposures of Canadian children residing in drug-producing homes. *The Journal of Pediatrics*, 159, 766-770.
- Moore, B. A., Augustson, E. M., Moser, R. P., & Budney, A. J. (2004). Respiratory effects of marijuana and tobacco use in a U.S. sample. *Journal of General Internal Medicine*, 20, 33 – 37.
- Moore, T.H.M., Zammit, S., Lingford-Hughes, A., Barnes, T.R.E., Jones, P.B., Burke, M., et al. (2007). Cannabis use and risk of psychotic or affective mental health outcomes: a systemic review. *The Lancet*, 370(1), 319-327.
- Mukamal, K.J., Maclure, M., Muller, J.E., & Mittleman, M.A. (2008). An exploratory prospective study of marijuana use and mortality following acute myocardial infarction. *American Heart Journal*, 155(3), 465-470.
- National Drug Intelligence Center. (2008). Marijuana. *National Drug Threat Assessment 2009*. Retrieved October 5, 2009 from <http://www.justice.gov/ndic/>

pubs31/31379/marijuan.htm

- Phan, T.D., Lau, K.K.P., & Li, X. (2005). Lung bullae and pulmonary fibrosis associated with marijuana smoking. *Australasian Radiology*, 49, 411-414.
- Plecas, D., Dandurand, Y., Chin, V. & Segger, T. (2002). *Marijuana grow operations in British Columbia: An empirical survey 1997-2000*. Vancouver, BC: International Centre for Criminal Law Reform and Criminal Justice Policy.
- Plecas, D., Diplock, J. & Garis, L. (2009). Commercially viable indoor marijuana growing operations in British Columbia: What makes them such a serious issue? Abbotsford, BC: University of the Fraser Valley.
- Plecas, D., Malm, A., & Kinney, B. (2005). *Marijuana growing operations in British Columbia revisited, 1997-2003*. Abbotsford, BC: University College of the Fraser Valley.
- Pletcher, M.J., Vittinghoff, E., Kalhan, R., Richman, J., Safford, M., Sidney, S., et al. (2012). Association between marijuana exposure and pulmonary function over 20 years. *Journal of the American Medical Association*, 307(2), 173-181.
- Potter, D.J., & Duncombe, P. (2011). The effect of electrical lighting power and irradiance on indoor-grown cannabis potency and yield. *Journal of Forensic Science*. DOI 10.1111/j.1556-4029.2011.02024.x
- Fratap, B., & Kormiyenko, A. (2012). Toxic effects of marijuana on the cardiovascular system. *Cardiovascular Toxicology*, 12(2), 143-148.
- Royal Canadian Mounted Police. (2010). *Drug situation in Canada – 2009*. Ottawa, ON: Royal Canadian Mounted Police.
- Safaa, A.M., Markham, R., & Jayasinghe, R. (2012). Marijuana-induced recurrent acute coronary syndrome with normal coronary angiograms. *Drug and Alcohol Review*, 31, 91-94.
- Safety Standards Act. (2004). *Electrical Safety Regulation*. Province of British Columbia. Retrieved October 4, 2009 from, http://www.qp.gov.bc.ca/statreg/reg/S/100_2004.htm
- Schneider, S. (2004). Organized crime, money laundering, and the real estate market in Canada. *Journal of Property Research*, 21(2), 99-118.
- Schuster, C., O'Malley, P. M., Bachman, J. G., Johnston, L. D., & Schulenberg, J. (2001). Adolescent marijuana use and adult occupational attainment: A longitudinal study from age 18 – 28. *Substance Use & Misuse*, 36, 997 – 1014.
- Sewell, R.A., Cohn, A.J., & Chawarski, M.C. (2008). Doubts about the role of cannabis in causing lung cancer. *European Respiratory Journal*, 32(3), 815.

- Shay, A. H., Choi, R., Whittaker, K., Salehi, K., Kitchen, C. M. R., Tashkin, D. P., Roth, M. D., & Baldwin, G. C. (2003). Impairment of antimicrobial activity and nitric oxide production in alveolar macrophages from smokers of marijuana and cocaine. *The Journal of Infectious Diseases*, 187, 700 – 704.
- Spiess, M. (2003). *Drug Data Summary*. Rockville, MD: Office of National Drug Control Policy. Retrieved October 5, 2009 from http://www.whitehousedrugpolicy.gov/pdf/drug_datasum.pdf.
- Tan, W.C., Lo, C., Jong, A., King, L., Fitzgerald, M.J., Vollmer, W.M., et al. (2009). Marijuana and chronic obstructive lung disease: a population-based study. *Canadian Medical Association Journal*, 180(8), 814-820.
- Tashkin, D.R. (2009). Does smoking marijuana increase the risk of chronic obstructive pulmonary disease? *Canadian Medical Association Journal*, 180(8), 797-798.
- Taylor, D. R., & Hall, W. (2003). Respiratory health effects of cannabis: Position statement of the Thoracic Society of Australia and New Zealand. *Internal Medicine Journal*, 33, 310–313.
- Tetraut, J. M., Crothers, K., Moore, B. A., Mehra, R., Concato, J., & Fiellin, D. A. (2007). Effects of marijuana smoking on pulmonary function and respiratory complications. *Archives of Internal Medicine*, 167, 221 – 228.
- Toonen, M., Ribot, S., & Thissen, J. (2006). Yield of illicit indoor cannabis cultivation in The Netherlands. *Journal of Forensic Science*, 51(5), 1050-1054.
- Vandrey, R., Umbrecht, A., & Strain, E.C. (2011). Increased blood pressure after abrupt cessation of daily cannabis use. *Journal of Addictions Medicine*, 5(1), 16-20.
- Van Ours, J.C., & Williams, J. (2009). Why parents worry: initiation into cannabis use by youth and their educational attainment. *Journal of Health Economics*, 28, 132-142.
- Zytaruk, T. (2009a). Drug bust: Bad guys, worse timing. *Now*. Retrieved August 18, 2009 from Canadian Newsstand.
- Zytaruk, T. (2009b). Family busted in grow rip investigation. *Now*. Retrieved August 18, 2009 from Canadian Newsstand.
- Zytaruk, T. (2009c). Wrong address for grow-rip bandits. *Now*. Retrieved August 18, 2009 from Canadian Newsstand.

Appendix I: Diplock et al. (2013) Targeting Marihuana Growing Operations in British Columbia



Introduction

Marihuana growing operations are an enduring crime and social problem for British Columbia. At the end of the 20th Century, the province had witnessed a surge in the number of marihuana growing operations coming to the attention of police forces. Growing in sophistication and increasingly moving indoors into residential neighbourhoods to avoid detection by law enforcement, the problem became just as much one of public safety as it was about the control of an illegal substance. Moving into the 21st Century, while the number of marihuana growing operations coming to the attention of police appeared to plateau, the size and sophistication of these operations had increased to the point where the same number or fewer of what had become much larger operations were producing far greater yields, supplying not just domestic consumption, but also largely fuelling international organized criminal drug trafficking. It became evident in many of the more urbanized centres that the traditional police response of waiting for public tips and complaints or coming across growing operation in the course of other police investigations was not adequate to combat the problem. Therefore, police tactics began to change in various locations around the province, accompanied by innovative, targeted approaches by other relevant stakeholders.

This project involves the cataloguing of much of the research that has focused on the problems of marihuana growing operations, highlighting the multiple facets of responses to this problem. The purpose of this report is to summarize this research in order to both document the various approaches used and identify the areas in which further action is needed. The report begins by providing background on the growth of the marihuana production industry in British Columbia. The subsequent section highlights what research suggests are some of the key reasons why British Columbians have been so concerned about this problem and the fact that it has become so entrenched into the criminal landscape of the province. The bulk of the report then discusses the various responses to marihuana production. This section begins with the criminal justice system approaches, focusing on tactics used by law enforcement, and then on outcomes to marihuana production cases in the courts. Following that is a discussion of the adoption of non-criminal justice legal response including the use of civil forfeiture, municipal strategies, and bylaws, in addition to the Province Government's legislative responses that have enabled them. Approaches taken in other social arenas, such as electrical consumption, real estate, and health care, will also be reviewed. Finally, the report ends with a discussion of some of the key challenges that could impede the progress made thus far, of which all concerned partners should be preparing to address.

Background

Plecas, Dandurand, Chin, and Segger (2002) studied the marihuana production industry in British Columbia, collecting and analyzing information on the characteristics of growing operations that came to the attention of police between 1997 and 2000. In 2005, the project was revisited, adding new data from the years 2001 through 2003 (Plecas, Malm, & Kinney, 2005). The conclusion from both of these studies was the British Columbia had a serious and substantial problem with marihuana production, and one that was trending toward becoming even more problematic. In general, cases of marihuana production increased across the province from 1997 to 2003, increasing by over 200% from 1997 to 2000 before largely levelling out from 2001 to 2003 (Plecas et al., 2005). Despite the plateau in terms of the number of marihuana growing operations that came to the attention of police, there was not a slowing in the actual growth of the industry across the province. Although the number of marihuana production cases appeared to stabilize, the size and sophistication of the operations showed continued increase. Over the seven years, the average marihuana

growing operation had gone from one with 9 high-intensity light set ups with 149 plants to a 16 light operation with 236 plants (Plecas et al., 2005).

More recent figures from 2010, presented by Plecas, Diplock, and Garis (2012), indicated that marijuana growing operations continued to grow in size and sophistication since the beginning of the 21st Century. The recent data on marijuana growing operations coming to the attention of police suggested that the average number of lights had increased to almost 30 (Plecas, Chaisson, Garis, & Snow, 2011). This increase in the average number of lights used for production is of key importance, suggesting that the average yield of illegal marijuana per operation increased nearly twofold since 2003. Unlike in previous decades where the size of a marijuana growing operation was measured in the number of plants and/or the amount of harvested product seized by police, it has become apparent through research (Bouchard, 2008; Toonen, Ribot, & Thissen, 2006) that the number and power of the lights present at the operation can provide a better measure of the scale of production. Typically, one can follow the grower's "rule of thumb", which for each 1000 W bulb used in production, an operation can yield one pound of harvested marijuana (Bouchard, 2008, p. 302).

As was reported by Garis (2005), "[t]he notion that grow operations are small independent outfits is an undated one" (p. 10). Many of the growing operations that are active in British Columbia, and, undeniably, the average operation that comes to the attention of police should be considered commercially viable operations that can generate large, tax-free, illicit revenue. According to Plecas et al. (2012), based on the potential yield of an operation and the average consumption of even the highest-consumption medical users, a marijuana growing operation with the equivalent of more than four 1000 W lamps should be considered commercially viable. Even with four lamps, an operation could potentially produce annually more than five times the amount of marijuana used by the average medical user.

However, because only relatively few growing operations are ultimately being discovered by police, there have been efforts to estimate the actual size of the marijuana industry in the province. An influential report by Easton (2004) inputted the number of police-discovered operations found by Plecas et al. (2002) into an economic model to estimate that number of growing operations across the province in 2000 was approximately 17,500, worth an estimated \$2 billion. An additional method to estimate the size of marijuana production industries, using a capture-recapture model, was explored by Bouchard (2007a) using information from the province of Quebec. Plecas, Diplock, and Garis (2009) used adaptations of both Easton's and Bouchard's methods to estimate the size of the industry, conservatively concluding that there were at least 10,000 active commercial marijuana growing operations in the province, producing an estimated \$1.67 billion worth of illegal marijuana. The authors (2012) recently updated their figures using 2010 data on police seizures and information from BC Hydro, estimating that the size of the industry at the end of the first decade of the 21st Century was around \$4.2 billion from over 13,000 active commercial indoor operations.

If these estimates are accurate, British Columbia's problem with marijuana should be considered one of the most sizeable in the world. This is particularly true of indoor, commercial marijuana production. Whereas other places around the globe tend to experience that majority of their marijuana cultivation outdoors (Bouchard, 2007a; Childress, 1994; Mallery, 2010; United Nations Office of Drugs and Crime, 2009, 2011, 2012), British Columbia's marijuana production industry has largely moved indoors. Between 1997 and 2003, approximately 16% of the operations discovered by police were located outdoors on private or public land, with the remaining 82% found primarily in residential houses and apartments or in outbuildings and even specially built bunkers (Plecas et al., 2005). In more recent studies of specific jurisdictions in British Columbia, the proportion of outdoor marijuana growing operations between 2006 and 2010 was lower, at 4% in the city of Mission (Plecas, Chaisson, Garis, et al., 2011), and 12% for the Cariboo region (Plecas, Chaisson, & Garis, 2011). The lower likelihood of detection by police (Bouchard, 2007a) combined with the

ability to grow larger crops on a year-round basis has likely contributed to the prominence of indoor growing in British Columbia. Indoor growing had become so prominent in British Columbia that the province experienced a related surge in the number hydroponic growing equipment retailers from 101 by 2002, almost ten times the number found in either Washington State or Alberta (Kirkpatrick, Hanson, Plecas, & Dandurand, 2002). The number has since decreased slightly (Bauman, Plecas, Taylor, Neal, & Huitson, 2006).

Compared with other high-producing jurisdictions, British Columbia's indoor marijuana production industry is on another level. Across Canada, other provinces face problems with indoor marijuana growing, but to a less extent than does British Columbia. Research on growing operations in Alberta by Plecas and Diplock (2007) found that there were on average just over 200 operations discovered by police, nearly 10 times fewer than in British Columbia. Recent figures from Statistics Canada data (as cited in Brochu, Beauregard, & Gagne-Tardif, 2007) showed a greater number of production incidents in Quebec than in British Columbia. However, estimates from Houchard (2007a) suggested that while Quebec had a sizeable marijuana production industry, it the data reveal that it likely has fewer cases of indoor growing than does British Columbia. While estimates of the number of growing operations in Ontario have been as high as 15,000 (LaBarge & Noakes, 2005), official statistics on drug production have indicated that a greater number of incidents of production are discovered in British Columbia (Brochu et al., 2007). Additionally, as of December 2012, under the Marijuana Medical Access Program, British Columbia also had the highest number of production licences, with more than 11,500 provided by Health Canada to growers across the province (Health Canada, 2013).

British Columbia also deals with a marijuana problem on a larger scale relative to other international jurisdiction. The province has often received international notoriety as a major source of marijuana (Gecelovsky, 2008; United Nations Office of Drugs and Crime, 2009). In the United States, California, the highest marijuana producing state (Gettman, 2006), along with other major marijuana producers like Kentucky (Gary Potter, Gaines, & Holbrook, 1990), are primarily experiencing problems with production outdoors. On a per capita basis, over 30 times the number of indoor growing operations are discovered in British Columbia as are in California¹. And, although the United Kingdom has seen a rapid growth in the number of indoor commercial growing operations (Association of Chief Police Officers, 2012), the 7,865 operations that came to the attention of police in the United Kingdom in 2011-2012 is actually more than 3.5 times fewer per capita than the approximately 2,100 discovered by police in British Columbia in 2010². While perhaps not considered on par internationally with those countries with massive outdoor cultivation problems (United Nations Office of Drugs and Crime, 2012), British Columbia's considerable concentration of indoor marijuana growing operations is almost unparalleled by other western democracies. This brings with it a multitude of harms and risks to the general public.

Harms and Risks of Growing Operations

The harms and risks associated to marijuana production have been well summarized by Plecas et al. (2012). While all illegal marijuana production brings with it inherent risks, the fact that these operations have moved

¹ According to data from the US Drug Enforcement Agency (2013), California experienced 505 indoor marijuana growing operation seizures by police in 2012. With California's population of over 37 million, British Columbia's 2,100 police seizures of indoor growing operations in 2010 (Plecas et al., 2012) and its population of only approximately 4.6 million indicate that the rate per population of growing operations could be higher than 30 times that of California.

² The 2,100 indoor growing operations in British Columbia in 2010 (Plecas et al., 2012) and a population of approximately 4.6 million indicate that the provinces per population rate of marijuana growing operations could be more than 3.5 times that of the United Kingdom. The (Association of Chief Police Officers, 2012) reported 7,865 commercial indoor growing operations in the United Kingdom for the country's population of approximately 63.2 million.

indoors, grown in size and sophistication, and proliferated across the province has created some substantial harms and costs for all British Columbians. There are risks to current and future inhabitants of properties used for marijuana production, to neighbours, and indeed to the surrounding community. Some of these harms have indirect effects on the entire province.

It is of note that although approximately 17% of British Columbians over age 15 reported previous year use of marijuana and many believe it can be used regularly with little harm (Stockwell, Sturge, Jones, Fischer, & Carter, 2006), research suggests that marijuana use will have some serious negative effects on a small portion of users (Diplock, Plecas, & Garis, 2012). Marijuana use results in some harms related to impaired, particularly when used while driving; social development and educational attainment, most notably for those who use at a young age; lung health; heart health; reproductive and foetal health; mental health; and dependency (Diplock et al., 2012). The potency of marijuana has also increased in some parts of the world (McLaren, Swift, Dillon, & Allsop, 2008), including Canada (Royal Canadian Mounted Police, 2010). Therefore, when considering that growing operations present some considerable risks to the communities of British Columbia, it should also be recognized that communities are being put at risk for the sake of the production of a drug that is itself of harm to users and is often produced and sold for the profit of organized criminal groups.

All growing operations pose some serious risks to British Columbia's communities, but indoor marijuana growing operations in residential dwellings are perhaps the most problematic. According to research by Plecas et al. (2012), indoor illegal marijuana production, particularly when done on a commercial scale, results in some sort of structural hazard or contamination in nearly all cases. These hazards are also shared by licenced medical operations (Garis & Clare, 2011). As residential houses are not originally designed to be ideal for indoor plant growing, buildings require substantial modifications to achieve a suitable environment. A number of extensive modifications are required including increased electrical power, altered ventilation, structural changes, added watering apparatuses, increased air flow, dehumidification, increased levels of carbon dioxide, added cooling units, and anti-detection measures. Johnson and Miller (2012) reported a particularly dangerous trend of growers disconnecting the furnace and re-venting the exhaust to rooms used for growing marijuana. The clandestine nature of this criminal enterprise results in growers circumventing the legal systems in place for making these types of modifications to buildings, which often require specific training, certification, and inspection to ensure safety standards are met. The substantially altered residence can present a number of hazards including fires (Garis, 2005; Plecas & Malm), electrical hazards (Garis, 2008), moulds (Johnson & Miller, 2012), and chemical residues (Blair & Weldman, 2009; Johnson & Miller, 2012).

Of particular concern is that the previously discussed hazards make marijuana grow operations much more potential harmful for youth and children than a typical home. While there are no current estimates of how many children live in homes used for marijuana growing it is known that children have been located in homes during police seizures (Plecas et al., 2005). Fortunately, however, despite the presence numerous serious risks, research has indicated that children found in and around marijuana growing operations are not significantly less healthy than other children, and there is little evidence available to indicate that children are often seriously harmed by living in or around marijuana growing operations (Douglas, 2010; Moller, Koren, Karasikov, & Garcia-Bourmissen, 2011). However, the presence of a thriving marijuana production industry has been found to offer avenues for young people to become involved in criminal activity. Research by Bouchard, Alain, and Nguyen (2009) indicated that in some areas of Quebec, the marijuana cultivation industry provided the opportunity for 12% of youth between age 13 and 17 to become involved in crime. Additional research suggested that the opportunity extends beyond those youth who were already involved in other criminal activity (Nguyen & Bouchard, 2010), and may lead to future criminal offending for youth who achieve success and develop networks with adult growers (Nguyen & Bouchard, 2011). It is possible that

young people in parts of British Columbia, particularly those living in and around growing operations, are exposed to these opportunities in addition to the other hazards of living around growing operations.

In addition to the harms that exist in and around indoor growing operations, the production of marijuana is closely linked to illicit drug trade and the criminal violence commonly associated with it. Between 1997 and 2006, approximately 6% of police seizures from residential growing operations located a firearm, and over 10% located at least one type of weapon (Plecas, 2007). There have been numerous cases in British Columbia where drug production has attracted violence to residential neighbourhoods, particularly in the form of home invasions (Plecas et al., 2012). Home invasions for the purpose of stealing drugs, money, and weapons, referred to as 'grow rips' when targeting marijuana growing operations, sometimes involve serious violence and the use of weapons and physical restraints. While, in most cases, it is active drug production sites that are targeted by other criminals set on 'ripping' the growing operation, there are cases in which neighbours and other properties that are not associated to growing have been victimized by mistake (Plecas et al., 2012). Outdoor growing operations as well as those indoor licensed growing operations are not immune to this criminal activity.

Marijuana growing operations present harms that extend to all British Columbians. Although there is no evidence to indicate that the purchase of properties for illegal marijuana production has driven up housing costs (Schneider, 2004), the proliferation of indoor marijuana growing operations over the years has led to the contamination and potential devaluation of numerous properties around the province. The costs of remediation to new home owners can be in the range of \$25,000 to \$100,000 (Plecas et al., 2012). In terms of electricity consumption and the theft of electric power, Diplock and Plecas (2011) estimated the costs to British Columbians as more than \$150 million. These costs are even more egregious when it is considered that illegal growers may also be generating over \$4 billion in untaxed revenue at the same time as forcing British Columbians to assume the various risks previously described (Plecas et al., 2012).

Criminal Justice System Responses

Policing Responses

Police in British Columbia have been responding to the illegal production of marijuana for decades, with the number of incidents increasing gradually until the 1990s (Brochu et al., 2007). As was reported by Plecas et al. (2002) and Plecas et al. (2005), by the end of the Twentieth Century, police were increasingly "busting" greater numbers of production operations every year. However, for the large majority of incidents, as the number of growing operations increased, police were relying on reactionary methods to respond to the problem, with investigations resulting from proactive police work in only 6% of cases (Plecas et al., 2005). In two more recent studies of marijuana growing operations in Mission, British Columbia (Plecas et al., 2011) and the Cariboo region of the province (Plecas, Chaisson, & Garis, 2011), the number of investigations starting as a result of proactive policing had decreased to zero by the period between 2006 and 2010.

Proactive police efforts have been most prominent with eradication initiatives for outdoor grows. In British Columbia, there are several regions that are particularly suitable for outdoor marijuana cultivation, and have experienced greater levels of outdoor growing. These areas, such as on and around Vancouver Island, have been targets for police eradication initiatives over the previous few decades (Bonchard, Beauregard, & Kalacska, 2011; Plecas et al., 2005). Eradication initiatives involve large coordinated police efforts to locate and destroy outdoor marijuana cultivation sites prior to harvesting near the end of the summer. Often, these

efforts involve the use of police aircraft or marine vessels to locate production sites that have not been previously reported.

The advantage for police of eradication initiatives, with their ability to locate operations across a large land area through the use of aircraft, is that they largely prevent outdoor growers from benefiting from the establishment of large cultivation sites on remote public lands. According to Plecas et al. (2005), eradication initiatives were responsible for a sizeable increase in the number of marijuana growing operations that came to police in the Vancouver Island Region of British Columbia between 1997 and 2003. As Bouchard et al. found, these initiatives put all outdoor growers at approximately the same level of risk, regardless of where they plan cultivate. The result has been the fragmentation of outdoor growing into a larger number of smaller sites in which growers compete for prime locations (Bouchard et al., 2011).

Eradication initiatives have also been common in the United States (Gettman, 2006; Mallery, 2010; Gary Potter et al., 1990), where outdoor growing is responsible for the majority of domestically produced marijuana. Similar to the findings of Bouchard et al. (2011), research by Gary Potter et al. (1990) found that eradication efforts by American police resulted in the dispersal growing operations into smaller-scale sites over a larger area. However, this actually resulted in increased sophistication, greater production, improvement to the quality of the production, and more public support for growers (Gary Potter et al., 1990).

These factors together might partially explain the existence of a different trend that occurred in the Cariboo Region of British Columbia, where the discovery of growing operations as a result of proactive police initiatives dropped to zero for the period between 2006 and 2010 (Plecas, Chaisson, & Garis, 2011). In this region, a tripling of the proportion of outdoor marijuana growing operations also coincided with a nearly three-fold increase in the number of growing operations coming to the attention of police in that area from 1997 to 2010. Given that proactive police discovery dropped and the vast majority were reported by anonymous complainants (Plecas, Chaisson, & Garis, 2011), the increase in the number of incidents likely represented an increase in the actual number of growing operations being established in the area. Moreover, unlike what was found on and around Vancouver Island, it appears that the size of outdoor growing operations in the Cariboo did not decrease. In fact the average number of plants per outdoor site increased by more than five times from 185 in the 1990s to 1,050 between 2006 and 2010. The tremendous growth in the number of outdoor cultivation sites was not the result of fragmentation of larger outdoor sites into multiple smaller ones to avoid detection from eradication initiatives, but rather the appears to have been the displacement of growing opportunities from other parts of the province to this region with fewer policing resources to target the problem.

Police investigations of marijuana growing operations are complex and require substantial resources. Even when tips come in from anonymous sources, police investigators require solid grounds before they can obtain search warrants (Plecas et al., 2005). Ginn (2007) argued that the complexity of marijuana production investigations had in all likelihood increased in a similar fashion to the increases observed for other police investigations as reported Malm et al. (2006; as cited in Ginn, 2007). While they are certainly aided by improvement to detection technology like forward looking infrared (FLIR) thermal scanning technology, there are numerous challenges. For many years from the 1990s and early 2000s, there was uncertainty about whether the use of FLIR technology to view the heat loss from potential growing operations was acceptable under section 8 of the Canadian Charter of Rights and Freedoms (1982). In the United States, the issues surrounding FLIR and the invasion of privacy also received a lot of attention (Barna, 1996; Julia, 2000; Plaschke, 1995; White, 1995), although unlike the ruling of the United States Supreme Court in 2001, the Supreme Court of Canada ruled in 2004 that police use of FLIR for surveillance did not constitute an unlawful search (McKee, 2005). Additionally, as police cannot enter properties without a warrant or other legal

grounds, there are still other barriers to successful investigations including the fact that growing operations are continuing to be established on larger properties (Girn, 2007) and the increasing trend of locating growing operations within large underground bunkers and outbuildings (Plecas, Chaisson, & Garis, 2011; Plecas, Chaisson, Garis, et al., 2011)

Given the challenges police have faced investigating growing operations and the relatively large number of operations coming to the attention of police, one effective response has been to establish dedicated marijuana growing operation investigation teams. Often previously referred to as "Green Teams", this police response began as a result of the rapid increase in the number of growing operations in the cities of British Columbia in the late 1990s. Malm and Tita (2007) argued that by 2000, communities in British Columbia had largely chosen one of four policing responses to address the problem of marijuana production: maintaining the status quo, suspending investigations of growing operations, reinforcing their existing drug teams, or establishing specialized marijuana production enforcement teams. The role of these teams was to investigate all reports of marijuana production, partner with other relevant agencies, and build awareness among the public to report incidents of production. The research indicated an 82% decline in marijuana production for the 14% of police forces that established a dedicated "Green Team" (A. E. Malm, 2006; A. E. Malm & Tita, 2007). Additionally, neighbouring jurisdictions that chose one of the other responses, though seeing a slowing of growth, experienced a 7% increase in the number of growing operations.

More recently, the Royal Canadian Mounted Police (Royal Canadian Mounted Police, 2011) have developed a national "Marijuana Grow Initiative" (MGI) to respond to the problem of marijuana production across Canada. Through the three pillars of the initiative (enforcement, deterrence, and awareness), the initiative emphasizes the use of specialized teams, similar to the previously discussed "Green Teams", but with increased analytical capacity, better collaboration with municipal inspection teams, closer relationships with Revenue Canada and Proceeds of Crime Investigators, and enhanced focus on developing technologies to better detect growing operations. The initiative started in September of 2011 (Royal Canadian Mounted Police, 2012) and while continuing to use previous policing strategies like specialized teams and eradication initiatives, the MGI has also established a national listing of all growing operations dismantled by the RCMP across Canada to increase awareness of the prevalence and harms of these operations in communities.

Even though the number of growing operations has dropped overall, the large numbers are still beyond what police can effectively respond to. Girn (2007), in reviewing police responses to marijuana growing operations, suggested that, based on the resource levels and response capability of investigators for the Surrey RCMP, a dedicated growing operation investigator could potentially respond to 21.5 growing operations in a year. For the approximately 4,500 growing operations coming to the attention of police in British Columbia per year (Plecas, Chaisson, Garis, et al., 2011), effectively investigating all these cases would take approximately 2.25% of the 9,292 authorized police resources in British Columbia (BC Ministry of Justice, 2013b). Despite continued effort by police to target marijuana production, the research has shown an inability for police to drive down production overall. While specialized teams have been effective at reducing the number of growing operations in some jurisdictions (A. E. Malm & Tita, 2007), other jurisdictions have seen unprecedented increases in the number and size of growing operations (Plecas, Chaisson, & Garis, 2011; Plecas, Chaisson, Garis, et al., 2011). Furthermore, the size, sophistication, and overall yields of these operations appeared to be only getting larger.

The inability for police to respond to the size of this problem and the complex requirements of investigations has been evident since the 1990s and appears to only be continuing. Plecas et al. reported between 1997 and 2003, the likelihood of police performing a full investigation on a reported marijuana growing operation decreased from 91% to 52%, and the likelihood that no action was taken increased from 7% to 22%. In

Mission and the Cariboo region, the likelihood of any action being taken after a report of marijuana growing fell from 82% to 49% and 90% to 31% respectively from the late 1990s to the period between 2006 and 2010 (Plecas, Chaisson, & Garis, 2011; Plecas, Chaisson, Garis, et al., 2011). Even for those investigations that end up resulting in a seizure, police have often not been in a position to make an arrest or recommend charges. These "no case seizures" rose from 35% of all seizures in 1997 to 64% in 2003, and by 2003 even occurred in 42% of cases in which suspects were found (Plecas et al., 2005). The trend of increasingly resorting to "no case seizures" reversed somewhat in Mission, as police may have put more effort into investigating only those cases in which evidence was strongest (Plecas, Chaisson, Garis, et al., 2011). However, in the Cariboo, the trend continued to get worse (Plecas, Chaisson, & Garis, 2011). While in many cases, these "no case seizures" were much more common for growing operations with relatively fewer plants, the average number of plants seized during "no case seizures" between 2006 and 2010 in Mission and in the Cariboo were 524 and 609 respectively (Plecas, Chaisson, & Garis, 2011; Plecas, Chaisson, Garis, et al., 2011).

However, despite the apparent lack of success at disrupting the industry overall, it is premature to assume that police responses are ineffective or unnecessary. As was seen by research on specialize investigative teams, having concerted police responses is much more effective at reducing the growth of marijuana production than doing no enforcement (A. E. Malm & Tita, 2007). Research by (Cohen, Plecas, McCormick, & Haarhoff, 2009) also found that in general, all marijuana crimes, including production, saw reductions in British Columbia, while increasing proportions of those crimes were being cleared through charges. Furthermore, operations in residential dwellings dealt with by police are very unlikely to be re-established in the same location (2007). Additionally, recent research by McGallaghy and McKeganey (2013) concluded that law enforcement efforts can increase the likelihood that drug users will seek treatment. Unfortunately, with effective strategies in some jurisdictions contrasted against insufficient policing resources in many other parts of the province, the nature of marijuana production has increasingly be characterized by the takeover of organized crime groups establishing increasingly sizeable and sophisticated operations in rural and under-resourced areas. If the trend continues that relatively few cases get investigated, and many of those that do fail to result in recommended charges, it cannot be expected that a few jurisdiction with effective police responses will have a deterrent effect on the province as a whole. The challenges facing police as they try to respond to the problems of marijuana production have necessitated more multifaceted approaches in which police are only one part of a larger targeted effort against the problem.

The Response from the Criminal Courts

It has been argued that in addition to a lack of policing resources to target growing operations, part of the problem with the criminal justice system response to marijuana production has been that even when police are able to establish a case, "bust" a growing operation, and recommend charges, the results at the court stage are insufficient (Gecelevsky, 2008). Despite the fact there has been a high likelihood of Crown laying charges when police made a seizure that resulted in the recommendation for charges, the disposition figures indicated that between 1997 and 2003, 44% of charged suspects had all of their charges result in a stay of proceedings (Plecas et al., 2005). Those figures also indicated that Crown Counsels were often strategically "trading off charges and the involvement of multiple accused" to improve the chances of conviction against some suspects, evidenced by the fact that only 52% of all suspects were found guilty on at least one charge, but at least on suspect was found guilty in 73% of cases (Plecas et al., 2005, p. 46).

When suspects involved in marijuana growing operations are found guilty, the sentences have not generally been onerous in light of the potential for illicit, tax-free profit and the potential harms they present to the community (Plecas et al., 2012). Plecas et al. (2005) reported that in 1997, fines of on average just under \$3,000 were most often the most serious sentence (in 34% of cases), followed by a custodial prison sentence

of on average around 4 months (in 19% of cases). However, by 2003, prison sentences of only slightly longer duration were the most serious sentence in only 10% of cases, with fines of on average just over \$2,000 being the most serious sentence in 32% of cases. Conditional sentences of on average 8 months, were commonly the most serious sentence in 2003. Although the maximum sentence for the production of marijuana under section 7 of the "Controlled Drugs and Substances Act" (1996) was 7 years imprisonment, no suspect studied by Flecas et al. (2005) received a custodial sentence of greater than five years.

Relative to other jurisdictions, the court response has been much less substantial in British Columbia at nearly every stage. Alberta, a Canadian jurisdiction in close proximity to British Columbia is a case in point. From their report on marijuana growing operations in Alberta, Flecas and Diplock (2007) reported that although the proportion of "no case seizures" increased from 1997 to 2004, at highest they were only 23%, versus 64% in British Columbia. Additionally, charges were laid in 99% of all case seizures, and only 27% of charged suspects had all of their charges stayed, versus 44% in British Columbia (Flecas & Diplock, 2007). In terms of the severity of the sentence, although prison sentences were ordered decreasingly over the 8 year period, they were consistently at least twice as common as in British Columbia and on average almost twice as long (Flecas & Diplock, 2007).

Compared to American jurisdictions, the difference is even more pronounced. At the time of the report by Flecas et al. (2005), approximately half of the sentenced growers in British Columbia would have been subject to five year minimum penalties in Washington State directly to the south of the province (Gecelovsky, 2008). However, recent changes to the "Controlled Drugs and Substances Act" (1996) that took place in 2012 may change this discrepancy. These changes have increased the maximum penalty to 14 years imprisonment and added mandatory minimum prison sentences of 6 months for growing operations with between 5 and 201 plants or of 9 months if a child was at risk or the operation presented a hazard in a residential area. As the changes are too recent to observe any noticeable additional deterrent effect, future analysis will be necessary to determine if these new sentencing requirements will have an effect on the marijuana production industry in British Columbia and across Canada.

Non-Criminal Justice Legal Responses

Municipal Initiatives and Bylaws

Acknowledging that the criminal justice system has been unable to adequately combat the spread of marijuana growing operations alone, additional responses have been developed to target the problem in other ways. Perhaps the most important innovative responses to the problem of marijuana production in British Columbia have come from municipalities. In 2005, the cities of Abbotsford and Surrey, British Columbia established public safety inspection teams in an attempt to respond to growing operations from a public safety approach in addition to the a criminal justice approach (Garis, Flecas, Cohen, & McCormick, 2009). These teams typically involved representation from the fire service, an electrical advisor, the police, and a building inspector. These teams were able to respond to reports of marijuana growing operations to inspect residences in order to address the public safety threats, and could do so without the complexity of a law enforcement response. Although initially, this approach lacked the deterrent effect of police intervention, evidenced by the fact that the re-establishment rate was three times higher for growing operations inspected by the public safety inspection teams than it was for police "busts", the enactment of city bylaws quickly reduced those reestablishment rates to zero (Gira, 2007).

Across British Columbia, and notably in the province's Lower Mainland area, municipalities have enacted and enforced bylaws that better enable the discovery and remediation of indoor marijuana growing operations (Garis et al., 2009). Generally these bylaws function by enabling a site inspection which is followed by a notice to prohibit occupancy, then the establishment of a timeline for remediation, and upon completion of the required remediation, the occupancy prohibition is lifted (Garis & Clare, 2011). Evidence has indicated that these responses have largely contributed to the reduction of the number indoor marijuana growing operations around the province and in the Lower Mainland in particular (Garis et al., 2009). Unfortunately, however these bylaws represent only a patchwork of responses across the province that provide inconsistent protection across the different municipalities of British Columbia.

There are critics of these approaches. It has been argued that city 'safety' bylaws and 'public safety' inspection teams are used to bypass legal protections Canadians are guaranteed from unlawful searches by police (Carter, 2009). Because these bylaws are meant to make enforcement cost-neutral, the costs are born by those subject to inspection through the use of large financial penalties (Garis et al., 2009). Since these responses appear to be effective, it is important for their continued use to find the appropriate balance between ensuring public safety without placing undue burden on those with high energy consumption for other reasons. Furthermore, continued evaluation of these initiatives and new innovative strategies is warranted.

Provincial Legislation

While innovative municipal responses and bylaws have been quite successful at addressing the public safety issues marijuana growing operations, changes to provincial legislation have facilitated these efforts and made them more effective. In 2006, the "Safety Standards Amendment Act" (2006) was passed by the Government of British Columbia. This legislation clarified privacy issues and enabled BC Hydro to share information identifying properties exhibiting overconsumption of electricity. With improved clarity, municipalities had greater confidence in using their bylaws to identify, dismantle, and remediate growing operations (Garis et al., 2009).

In 2009, another important change occurred. Changes were made to the Contaminated Sites Regulation under the "Environmental Management Act" (2003) requiring the remediation of marijuana growing operations and other drug production labs to be made at the property owner's expense. This change has also enabled municipalities to prohibit occupancy of an identified growing operations until they receive confirmation from the Ministry of Environment that remediation has been completed. It has also allowed for remediated site used for marijuana production to be recorded on an online registry.

Recently, the Government of British Columbia passed the "Community Safety Act" (2013), which is said will create a new provincial unit to respond to 'threatening and dangerous activities'. This unit will respond to complaints from British Columbians of activities such as growing operations that present risks to public safety, following up by conducting investigations, working with the property owners, and potentially applying for community safety orders. While there is potential for this legislation to help address the problem of marijuana production in British Columbia, time will reveal whether or not it will result in new effective responses.

Civil Forfeiture

Following actions in Ontario, British Columbia passed the "Civil Forfeiture Act" (2005) as an additional deterrent to criminal behaviour. This act allows "the Director of Civil Forfeitures to initiate civil court proceedings against property believed to be the instruments or proceeds of unlawful activity" (BC Ministry of

Justice, 2013a). Information from DataBC, an open access website made available by the Government of British Columbia (2013), indicates that the property against which proceedings are initiated have most often included cash, cell phones, cars and other vehicles, and real estate. As of 2011, the Civil Forfeiture Office (CFO) can proceed through an administrative process against property other than real estate that is valued at \$75,000 or less (BC Ministry of Justice, 2013a).

Given a lower standard of burden for making a case civilly compared to the criminal process, this legislation has been used effectively to forfeit the property and profits from growers used for or obtained through their illegal activities. Even in cases where criminal charges are stayed, the use of Civil Forfeiture proceedings can be used as a measure to reduce some of the rewards of illegal marijuana production. Data from DataBC (Government of British Columbia, 2013) indicates that the Civil Forfeiture Office has been viewed as an effective avenue to deal with drug crimes, including the production of marijuana. Over 57% of all civil forfeiture cases referred to the CFO by police in British Columbia since 2007 have involved either trafficking, possession for the purposes of trafficking, or production. Production offences, the majority of which are likely to be marijuana production, make up nearly 21% of all police referred cases.

Despite the potential for civil forfeiture to be a means to reduce some of the rewards of marijuana production and provide compensation to victims and funding for other crime prevention programs, there are critics of the approach. (Mulgrew, 2013) argued that civil forfeiture has turned into a government money grab that is not targeting the serious organized criminals as was intended, but is instead targeting the "low hanging fruit" of first-time criminals who have little means to dispute the forfeiture in court. While the same may not be true for all crimes targeted by the CFO, marijuana growing operations can be very profitable criminal ventures (Flecas et al., 2012), and therefore, measure to negatively impact on this profitability is necessary, particularly given the fact that fewer of these operations can be considered low-level.

Other External Stakeholder Responses

Public Health and Medical Approach

In response to the perceived lack of success of prohibition policies and law enforcement efforts to reduce the use of marijuana, the size of the industry, and the harm to users, many have called for a more public health approach to the problem of marijuana (Fischer et al., 2011). This approach would focus more on targeted treatment and appropriate messaging to reduce the likelihood of harms to those groups most at risk. Additionally, increasing numbers of British Columbians are viewing marijuana as a legitimate medicine to address some illnesses, and a sizeable portion of the user population as medicinal users. However, despite the merits of a public health approach, too often the focus of the discussion around marijuana and health has been on how to get more people legitimate access to it rather than on preventing the harmful use of the drug.

In 1999, Health Canada began introduced Marijuana Medical Access Program (MMAP), and in 2000, the Marijuana Medical Access Regulations were established. The program and regulations recognized the medical use of marijuana and permitted physicians to prescribe marijuana medicinally to patients who receive licensed authorization to possess specified amounts of the drug. With few legal sources of marijuana, the MMAP also began issuing licences to medicinal marijuana users and designates to permit the cultivation of specified amount of marijuana for medicinal use. While the program began with relatively small numbers, by December of 2012, there were 28,115 licensed medicinal users and 21,468 licensed producers across Canada, with the greatest number of each located in British Columbia (Health Canada, 2013), a considerably disproportionate distribution of these licences given the population and licences provided elsewhere (Garis &

Clare, 2013b). However, these production licences will no longer be valid following changes that will take effect on April 1, 2014.

The constant growth and susceptibility for abuse of the program caused many to view the MMAP as a substantial contributor to the problem of illegal marijuana production in British Columbia and across Canada. Perhaps because the regulations need to account for production times, daily medical use, the shelf life of dried marijuana, and the typically higher quantities needed by medical users, the amounts authorized by Health Canada for production are relatively high. Additionally, the production licences set out the maximum number of plants per licence, although research indicates that the yield, particularly for indoor growing is more dependent on the light source than the number of plants (Bouchard, 2008; Toonen et al, 2006). Although the regulations prohibit the sale of medical marijuana to recreational users and other unauthorized distributors, there is a belief that organized crime groups have taken advantage of lax regulations to obtain medical production licences to protect their illegal growing operations from law enforcement (Royal Canadian Mounted Police, 2010).

There were other concerns about the MMAP and the authorization to produce marijuana for medical purposes. Primarily, although the regulations require licensees to inform their local municipalities if they plan to grow indoors and ensure that their operations meet zoning restrictions, building codes, and other safety regulations, this has not been the case for many licenced growers (Garis & Clare, 2011, 2013b; Jessop & Garis, 2008). Licenced marijuana growing operations operating indoors are therefore presenting many of the same harms to communities as their illicit counterparts. Additionally, despite the phasing out of production licences, there is no current plan to provide municipalities with additional information or tools to effectively remediate properties that were formerly being used to produce marijuana under the MMAP (Garis & Clare, 2013b). Furthermore, it remains unclear what, if any, additional issues might accompany the transition to newly authorized commercial producers of medical marijuana. This area will likely continue to require considerable attention from policy makers and researchers to find ways to meet the needs of medical users, while promoting reducing the potential harms of marijuana consumption and protecting British Columbia's communities from the hazards associated with illegal and unsafe authorized growing operations.

BC Hydro's Response

Since growing operations have become predominantly indoor ventures, growers have relied on electrical power to produce their crops. For those who do not resort to using generators, the options appear to be to either accept the expense of high electricity consumption or steal electricity through the use of a bypass. For the average growing operation paying for power, the consumption was found to be around 110,000 kWh of electricity per year, which jumped to over 180,000 kWh per year for those operations that involve electricity theft (Diplock & Plecas, 2011). This represented an enormous cost to both British Columbian rate payers and BC Hydro, the province's Crown Corporation responsible for generating and distributing electric power.

The issues of excessive consumption and electricity theft have made marijuana growing operations a considerable problem for BC Hydro. In their study, Plecas et al. (2005) found that approximately 21% of all founded cases of marijuana production involved the theft of electricity between 1997 and 2003. The prevalence of marijuana growing operations that steal electricity was found to have doubled since that time to over 50% by 2010 (Diplock & Plecas, 2011). Moreover, the size of operations and therefore the amount of electricity being stolen has also increased.

BC Hydro has contributed to the reporting of growing operations, particularly those involving theft of electricity for many years. Data from the study by Plecas et al. (2005) revealed that 3% of the marijuana

growing operations that came to the attention of police were reported by the corporation. This trend saw a relatively large decline from 8% in 1997 to only 2% by 2003. Issues around privacy for sharing information, particularly which of paying customers, likely contributed to inability for a greater number of investigations to benefit from the knowledge of excessive consumption (Garis et al., 2009). However, with the formation of partnerships between BC Hydro and municipalities in combination with the passing of the "Safety Standards Amendment Act" (2006), consumption data supplied by BC Hydro has provided much needed evidence to effectively use municipal bylaws and other innovative approaches.

In addition to sharing consumption data with authorities, in 2011, BC Hydro initiated a program of replacing its former metering system with wireless Smart Metering technology. This technology was viewed by some as having the potential to reduce some of the harms caused by indoor marijuana production by identifying electricity theft and other dangerous consumption earlier (Diplock & Plecas, 2011). While the program has not been operating long enough to adequately assess its merit in this regard, early evaluative data presented by Garis and Clare (Garis & Clare, 2012) showed that residential fires resulting from illegal marijuana growing operations and the use of electrical bypasses and high intensity growing lamps had been reduced when comparing a one-year post implementation period to the immediately preceding one-year pre implementation period. Further research will need to be done to determine if Smart Metering has been able to achieve any reductions in the theft of electricity by growing operations and/or the number of active growing operations in the province.

Responses from the Real Estate Industry

Marijuana growing operations on private property can leave behind some serious potential hazards when their operators are forced to abandon their activities or decide to move on to other sites (Plecas et al., 2012). Given the longevity of this problem, the prevalence of growing operations that have been identified by authorities every year, and the likely very large number that have not, there are thousands of residential properties across the province that have previously been used to house a growing operation. The changes to residential properties and the potential risks associated to criminality that may be linked to the property can negatively affect future occupants. Real estate agents and the organizations that represent them have been aware of these issues for years and have been working toward strategies to reduce the negative impact of growing operations on home buyers in British Columbia.

In 1991, the British Columbia Real Estate Association (BCREA) introduced the Property Disclosure Statement (PDS). It provides a list of questions that ask property sellers to indicate to the potential buyers whether any of a number of potential problems might exist. In 2004, the disclosure of former marijuana growing or other drug production was added to the PDS, allowing buyers to get information about whether or not the existing owner of a property is aware of such activities in the property's past. The illegal use of a property for producing marijuana may be considered to be a material latent defect, which legally must be disclosed. However, no established rules have been legislated or established through court rulings to determine under which circumstances this would apply. While buyers of former drug production properties may have some legal recourse if a seller fails to disclose the history, particularly if a PDS was included in the contract, such a route is not guaranteed to work. There is no onus on owners selling their property to make additional effort to determine if the property has a history of drug production of which they are unaware. In essence, even with these protections in place, it remains a case of "buyer beware".

Garis and Clare (2011) also reported on some of the strategies being employed by municipalities in the province to help provide prospective home buyers with information about whether a property formerly housed a growing operation. Given the bylaws in place in some municipalities, following the discovery of an

indoor growing operation, a notice to prohibit occupancy will be applied to ensure remediation work is done. Typically, afterwards there might be little in place to disclose the history that the property has been remediated (Garis & Clare, 2011). The City of Surrey however, requires the disclosure of that history and its remediation status to any future occupant, with this requirement passing to all future owners into perpetuity. A notice is included with the property tax documentation. Other municipalities remove the record of a property's history as a growing operation after remediation, keeping only a listing of these properties at city hall, or making the history of a property available only upon a freedom of information request (Garis & Clare, 2011).

While there are some strategies in place to protect the public from unknowingly accepting the risks of buying a former growing operation, more is needed. Garis and Bond (2010), in their analysis of this issue found that the "Freedom of Information and Protection of Privacy Act" (1996) created barriers to the sharing of important information with potential homebuyers. They suggested a need for further responses such as the crafting of preapproved questions that municipalities can use to provide information to the public, seller's consent to disclosure forms, and even additional questions that may require formal Freedom of Information requests (Garis & Bond, 2010). Additionally, the BCREA (2012, p. 1) and Garis and Clare (2011, pp. 13 - 14) recommended the following three future steps: 1) "Develop a centralised, consistent process for the disclosure of property history information [; 2] Develop a centralised, consistent process for remediation of buildings used in drug operations [; and 3] Implement these disclosure and remediation processes through existing BC provincial legislation". If these and/or other additional strategies are put in place in British Columbia, it will be necessary to follow up and assess the impact that they have on public safety and whether or not they will contribute to other strategies designed to eliminate growing operations from residential properties.

Responses Related to Remediation

Given the fact that there are thousands of properties that have previously housed growing operations, it is also important to note that there are currently no provincial standards in place to ensure the quality of remediation when these operations are discovered. While it may be difficult to protect the public from growing operations that have not been discovered, there is a greater opportunity to ensure those that have been discovered are returned to a safe state for people to occupy. As it stands, the responsibility for setting remediation standards has fallen to municipalities, and therefore, the inspection of reported properties and cleaning requirements vary by municipality (Garis, 2010). As the public safety bylaws have placed the onus on the owners of properties to have them remediated, many of the decisions made in the process are done with the owner's interests in mind and potentially not necessarily in the interest of public safety. Garis (2010) argued that this has led to inconsistent results all across British Columbia, meaning that a residence that is said to have been "remediated" could have been done to a very different standard depending on where it is located. In order to have greater confidence in the remediation of former marijuana growing operations, which may in turn create safer communities and greater confidence in the real estate market, further steps need to be taken on this issue.

Focusing on Retailers of Equipment Used for Marijuana Production

Another area that has been recognized as having the potential to substantially limit the continued viability of marijuana production in British Columbia is the regulation of the sale of hydroponic equipment. Examinations of the equipment seized from marijuana growing operations in the Lower Mainland demonstrated that almost all operations use the same types of equipment, such as timers, lights, transformers, CO2 generators, and Ozone generators, and in many cases there are common brands used (Garis & Plecas,

2007). Although the over number of specialty hydroponic equipment retailers and the prevalence of their advertising have decreased over the past decade, they are still much more numerous than what exists in nearby Alberta and Washington (Bauman et al., 2006; Garis & Clare, 2013a; Kirkpatrick et al., 2002). It is believed that effective regulation could not only limit access to the necessary equipment for the criminal production of marijuana, and thus reduce the likelihood that criminals would be able to start and maintain operations, but could also decrease the number of electrical and fire hazards associated to growing, whether illegal or authorized (Garis & Clare, 2013a).

Although the need for regulation of equipment retailers that knowingly or unknowingly facilitate marijuana production has been expressed for many years (Bauman et al., 2006; Garis, 2008), there are not yet any regulations in place. Garis and Clare (2013a) have outlined three options that could be implemented in British Columbia to target this issue. The first would involve changes to the "Canada Consumer Product Safety Act" (2010), which could then require retailers to collect and report customer and purchase information and to report any health and safety incidents that occur involving the equipment that they have supplied. The second option would be to implement municipal bylaws to prohibit the sale of specified equipment to customers who fail to show a valid permit for the use of the equipment or its installation. The third option would be to require the retailers and customers to obtain licences to sell and possess the equipment respectively, which could involve background checks. If indeed regulatory strategies are implemented to address the production of marijuana from this potentially effective avenue, further research will need to assess their effectiveness in terms of improving safety and reducing the number of incidents of illicit growing.

Future Challenges

As this report has summarized, there are a number of approaches that have been taken or explored in British Columbia to address the issues of marijuana growing operations. Prior to the mid-2000s, this problem was largely viewed as a law enforcement and criminal justice issue, the spread which partners working in those areas had been hitherto been unable to effectively stem. While marijuana growing operations continue to be a major concern for the communities of British Columbia, additional multifaceted responses by police, the courts, municipalities, the provincial government, and other stakeholders working in concert have seen some notable successes. Continued efforts to develop effective and innovative strategies to reduce both the prevalence of marijuana growing operations and their potential for harm are necessary, and this report has highlighted some of those areas where further efforts and research are needed to address gaps.

Responding to the New Medical Marijuana Regulations

However, while there have been some successes, continuing to gain effective results from these strategies and finding ways to effectively implement additions ones will face some substantial future challenges. The recent changes to the MMAP will likely create some challenges for those hoping to reduce prevalence and harms of marijuana production. Public opinion and political shifts on the issue of the criminalization of marijuana, and by association the related issues such as production, may present additional challenges. Finally, the development of a marijuana growing "cottage industry" in some rural and otherwise economically limited regions of the province will continually present a challenge to these goals.

There is potential for the phasing out of personal and designated production licences formerly under the MMAP to provide law enforcement with additional tools to prevent the production of marijuana by organized criminals who are now believed to be effectively abusing the current system (Royal Canadian Mounted Police, 2010). Such changes will undoubtedly make it simpler to differentiate between authorized and illegal producers, when operations come to the attention of police and other authorities. At the same time however,

with over 11,500 production licences in British Columbia, the process of enforcing these changes and ensuring that residences formerly used for growing are effectively remediated will not be an easy one. A plan for sharing information to municipalities and other authorities to accomplish this has not been outlined by Health Canada (Garis & Clare, 2013b). This is a challenge that will need to be overcome in the near future.

Additionally, despite the efforts to outline regulatory requirements for authorized producers, the process of regulating them, given the strong existing links between this industry and organized crime, will also be a challenge. Given the disproportionate number of medical licensees in British Columbia relative to other Canadian jurisdictions (Health Canada, 2013), it appears that there has been a greater impetus for abuse of the existing system in this province than in any other, which may simply continue under the new Marijuana for Medical Purposes Regulations regime. Just as many of those currently investigated for illegal marijuana production are often "sitters" with little to no criminal history³, similar associates of organized criminal groups may be put in positions by these groups to gain access to production authorization. Furthermore, for those medical users who had been growing for their own personal use and who do stop, they will likely experience somewhat greater financial strain in acquiring their medications. If illegal suppliers can draw a portion of these former growers toward their product and away from that of legitimate authorized producers, whether through lower prices or the same stigmatization that was applied to the marijuana produced by Health Canada's growers⁴, organized criminals may experience increased demand for their illicit marijuana as a result. While these changes represent a positive step toward correcting the deficiencies with the regulation of medical marijuana, further attention will be needed to monitor the problem in light of these changes.

Addressing the Problem in Rural Communities with a Marijuana "Cottage Industry"

While largely undocumented, several communities in British Columbia may be nearly reliant on the cottage industry of marijuana production. Research from the United States has identified similar rural areas in which these dynamics exist (August, 2012). In these communities strategies intended to eliminate growing operations and seriously punish operators will likely face considerable opposition. Research by Decorte (2010b) found that smaller scale producers can be a sizeable portion of the market in some marijuana producing regions, and may achieve public support from consumers who feel they get better quality control and are not contributing to their money to organized criminals. As was found by Gary Potter et al. (1990), police enforcement strategies targeting marijuana production in economically fragile, rural locations have the potential to make production more elusive and to actually build public support for the activity and weaken support for police. Similarly, Decorte (2010a) has argued that repressive policing strategies are more likely to drive small-scale producers out of the market, only to be replaced by large-scale organized criminal producers, from his perspective a greater of two evils. Given the real possibility that such markets may exist in communities in British Columbia, and the recent trends toward increased size, sophistication, and organized criminality across the marijuana production industry in British Columbia, it is important to note the challenges that responding to the existence of this phenomenon in these rural communities could involve.

³ In the report by Piccas et al. (2005), nearly half of all suspects associated to marijuana growing operations had no prior criminal convictions. Similar results were found by Piccas and Diplock (2007) and A. E. Malin (2006). The likelihood of having a criminal record was considerably lower for some groups of suspects believed to have been recruited by organized criminals simply to tend to the plants.

⁴ Early feedback from medical users of Health Canada's supply of marijuana was that it was of poor quality (Picard, 2012). This reputation stuck and may have led to pressure to implement the production licensing regime under the MMAF.

New Challenges Associated to the Trend toward Legalization

Recent changes to laws in the states of Washington and Colorado in the United States may end up being catalysts for a trend of legalization of the recreational use of marijuana. As of 2010, Angus Reid reported that 53% of Canadians, including 61% of British Columbians, were in favour of legalization of marijuana for recreational purposes. There are many advocates for changes to the laws to allow for legal marijuana, some of whom are from groups not traditionally associated to the cause such as former politicians and police leaders, academics, lawyers, and physicians (Stop the Violence BC, 2011). These advocates have argued that the legalization of marijuana in Canada would reduce levels of violence stemming from the illicit trade of the drug by organized crime groups, and that continued efforts to use law enforcement and related strategies to curb supply simply cause more incentives for new illegal producers to enter the market (Stop the Violence BC, 2011). To some extent, research by Bouchard (2007b) supported the latter point. Additionally, dissatisfaction with drug policies has often led to arguments that the prohibition approach not only expends government resources on law enforcement and other tactics, but also leaves untapped a predicted glut of potential tax revenue (Caputo & Ostrom, 1994; Gettman, 2007).

Although the Angus Reid report (2010) indicated that 70% of Canadians, including 69% of British Columbians, are in favour of mandatory minimum sentences and high fines for illegal marijuana producers, it is unclear whether further pressure for or even the eventual legalization and normalization of marijuana would change that. Regardless, in a climate of increasing public sentiment towards the legalization and regulation of the marijuana industry, political appetite for responses that target any aspect of this market may only decrease, viewed as another arm of the "war on drug" that opponents are trying to paint as antiquated and contributory to the problem. With the Government of Canada set to authorize private commercial growers to produce medical marijuana and states south of the border exploring similar systems to make recreational marijuana available, steps toward the viewing of marijuana production as normative are potentially well underway. If such a trend does eventually lead to legalization of marijuana in Canada, and thus British Columbia, those concerned about the harms associated to the production of marijuana will need to be prepared for the challenges that will result from such a transition, including efforts on the part of organized criminals to profit in the short term from the confusion and potential for a short term peak in demand⁵.

Conclusion

British Columbia's problem with marijuana production has been particularly resilient, proliferating rapidly in the 1990s before becoming one characterized by slightly fewer but larger, more sophisticated, and more organized growing operations. This evolution has created the need for all relevant stakeholders to develop effective partnerships and innovative responses to address the problem. This report has highlighted the main responses from several related areas that have been implemented in British Columbia and identified some areas where more work is needed. The research that is cited throughout this report has been compiled into an associated library that can be used to guide policy makers looking to find solutions to address the problems associated with marijuana production. As efforts to reduce the harms to British Columbians caused by marijuana production will face some considerable challenges in the near future, it remains an important task

⁵ According to research by (Williams, 2004), a change in the legal status of marijuana would likely increase the prevalence of use by adult males. Additionally, (Caulkins, 2010) argued that legalization would likely substantially decrease the price of marijuana, which would increase the demand among some portion of the population, namely youth (van Curs & Williams, 2007; Williams, 2004). While research on states that have recently implemented systems of marijuana is necessary to determine whether consumption would increase as was predicted by Caulkins, Köhler, MacLagan, Pacula, and Keuter (2012).

for those working toward increased public safety to continue to seek innovative responses and to document and evaluate the outcomes of their efforts.

References

Cited Sources

- Angus Reid. (2010). Majority of Canadian Would Legalize Marijuana, But Not Other Drugs [Press release]
- Association of Chief Police Officers. (2012). Commercial cultivation of cannabis 2012 UK National Problem Profile: Association of Chief Police Officers.
- August, K. D. (2012). *Playing the Game: Marijuana Growing in a Rural Community*. (Master of Arts), Humboldt State University, Arcata, CA.
- Barna, J. F. (1996). Reforming the Katz Fourth Amendment Reasonable Expectation of Privacy Test: The Case of Infrared Surveillance of Homes. *Wash. UJ Urts. & Contemp. L.*, 49, 247.
- Bauman, D., Plecas, D., Taylor, W., Neal, P., & Huitson, N. (2006). *Revisiting Hydroponic Cultivation Equipment Outlets in British Columbia, Alberta, and Washington State*. Abbotsford, BC: University College of the Fraser Valley.
- BC Ministry of Justice. (2013a). Civil Forfeiture in British Columbia. Retrieved June 24, 2013, from <http://www.pssg.gov.bc.ca/civilforfeiture/>
- BC Ministry of Justice. (2013b). *Police Resources in British Columbia, 2011*. Victoria, BC: BC Ministry of Justice.
- Blair, J., & Weldman, G. (2009). Residual pesticides in former marijuana grow-operations: Determining safe levels.
- Bouchard, M. (2007a). A Capture-Recapture Model to Estimate the Size of Criminal Populations and the Risks of Detection in a Marijuana Cultivation Industry. *Journal of Quantitative Criminology*, 23(3), 221-241. doi: 10.1007/s10940-007-9027-1
- Bouchard, M. (2007b). On the Resilience of Illegal Drug Markets. *Global Crime*, 8(4), 325-344. doi: 10.1080/17440570701739702
- Bouchard, M. (2008). Towards a Realistic Method to Estimate Cannabis Production in Industrialized Countries. *Contemp. Drug Probs.*, 35, 291.
- Bouchard, M., Alain, M., & Nguyen, H. (2009). Convenient labour: the prevalence and nature of youth involvement in the cannabis cultivation industry. *Int J Drug Policy*, 20(6), 467-474. doi: 10.1016/j.drugpo.2009.02.006
- Bouchard, M., Beaugregard, E., & Kalaska, M. (2011). Journey to Grow: Linking Process to Outcome in Target Site Selection for Cannabis Cultivation. *Journal of Research in Crime and Delinquency*, 50(1), 33-52. doi: 10.1177/0022427811418001
- British Columbia Real Estate Association. (2012). Health, Safety and Peace of Mind [Press release]
- Brochu, S., Beaugregard, V., & Gagne-Tardif, X. (2007). *Cannabis Cultivation in Canada: International Centre for Comparative Criminology*.
- Caputo, M. R., & Ostrom, E. J. (1994). Potential tax revenue from a regulated marijuana market: A meaningful revenue source. *American Journal of Economics and Society*, 53(4), 475 - 490.
- Carter, C. (2009). Making residential cannabis growing operations actionable: a critical policy analysis. *Int J Drug Policy*, 20(4), 371-376. doi: 10.1016/j.drugpo.2008.11.001
- Caulkins, J. P. (2010). *Estimating the cost of production for legalized marijuana Working Paper*. Santa Monica, CA: RAND.
- Caulkins, J. P., Kilmer, B., MacCoun, R. J., Pacula, R. L., & Reuter, P. (2012). Design considerations for legalizing cannabis: lessons inspired by analysis of California's Proposition 19. *Addiction*, 107(5), 865-871. doi: 10.1111/j.1360-0443.2011.03561.x
- Childress, M. T. (1994). *A system description of the marijuana trade*. Santa Monica, CA: RAND.
- Cohen, I. M., Plecas, D., McCormick, A. V., & Haarhoff, T. (2009). *Police statistics on marijuana drug files in Surrey, the Lower Mainland, and the rest of British Columbia 2004 - 2008: A comparative analysis*. Abbotsford, BC: University of the Fraser Valley.

- Decorte, T. (2010a). The case for small-scale domestic cannabis cultivation. *Int J Drug Policy*, 21(4), 271-275. doi: 10.1016/j.drugpo.2010.01.009
- Decorte, T. (2010b). Small scale domestic cannabis cultivation: an anonymous web survey among 659 cannabis cultivators in Belgium. *Contemp. Drug Probs.*, 37, 341.
- Diplock, J., & Plecas, D. (2011). *The Increasing Problem of Electrical Consumption in Indoor Marijuana Grow Operations in British Columbia*. Abbotsford, BC: University of the Fraser Valley.
- Diplock, J., Plecas, D., & Garis, L. (2012). An updated review of the research on the risks and harms associated to the use of marijuana. *Journal of Global Drug Policy and Practice*, 6(3).
- Douglas, J. (2010). *The Health and Safety of Children Living in Marijuana Grow Operations: A Child Welfare Perspective*. (Doctor of Philosophy), University of British Columbia, Vancouver, BC.
- Easton, S. T. (2004). *Marijuana Growth in British Columbia Public Policy Sources*. Vancouver, BC: The Fraser Institute.
- Fischer, E., Jeffries, V., Hall, W., Room, R., Goldner, E., & Kehm, J. (2011). Lower risk cannabis use guidelines for Canada (LEKUG): A narrative review of evidence and recommendations. *Can J Public Health*, 102(5), 324-327.
- Garis, L. (2005). *Eliminating residential marijuana grow operations - An alternative approach: A report on Surrey, British Columbia's Electrical and Fire Safety Inspection Initiative*. Surrey, BC: City of Surrey, Fire Service.
- Garis, L. (2008). *Eliminating Residential Hazards Associated with Marijuana Grow Operations and the Regulation of Hydroponics Equipment: A Brief on British Columbia's Public Safety Electrical Fire and Safety Initiative*. Surrey, BC: Fire Chiefs' Association of British Columbia.
- Garis, L. (2010). *Improving the remediation process for marijuana grow operations*. City of Surrey, Fire Service. Surrey, BC.
- Garis, L., & Bond, J. (2010). *Disclosure of controlled substance properties and the Freedom of Information and Protection of Privacy Act*. Surrey, BC: City of Surrey.
- Garis, L., & Clare, J. (2011). *Responding to unhealthy properties: Developing a centralized, consistent process for community safety*. Fraser Valley Real Estate Board, Surrey, BC.
- Garis, L., & Clare, J. (2012). *Assessing the safety of Smart Meter installations in British Columbia: Analysis of residential structure fires in BC between July 2010 and June 2012*. Abbotsford, BC: University of the Fraser Valley.
- Garis, L., & Clare, J. (2013a). *Regulatory Options to Prevent the Unsafe Use of High-powered Hydroponic Equipment*. Abbotsford, BC: University of the Fraser Valley.
- Garis, L., & Clare, J. (2013b). *What the Marijuana for Medical Purposes Regulations overlook: Disclosure and remediation of inappropriately used dwellings*. Abbotsford, BC: University of the Fraser Valley.
- Garis, L., & Plecas, D. (2007). *An Analysis of Marijuana Grow Equipment Seized from Lower Mainland Operations*. Abbotsford, BC: University of the Fraser Valley.
- Garis, L., Plecas, D., Cohen, I. M., & McCormick, A. V. (2009). *Community response to marijuana grow operations: A guide towards promising practices*. Abbotsford, BC: University of the Fraser Valley.
- Gecelovsky, P. (2008). Canadian Cannabis: Marijuana as an Irritant/Problem in Canada-U.S. Relations. *American Review of Canadian Studies*, 38(2), 207-212. doi: 10.1080/02722010809481709
- Gettman, J. (2006). *Marijuana production in the United States*. *The Bulletin of Cannabis Reform*.
- Gettman, J. (2007). *Lost taxes and other costs of marijuana laws*. *The Bulletin of Cannabis Reform*.
- Girn, F. (2007). *An alternative response model to marijuana grow operations: Electrical fire and safety investigation initiative as a case study*. (Masters of Arts), University of the Fraser Valley, Abbotsford, BC.
- Government of British Columbia. (2013). *DataBC Main Page*. Retrieved June 26, 2013, from <http://www.data.gov.bc.ca/>
- Health Canada. (2013). *Marijuana Medical Access Program Statistics*. Retrieved June 23, 2013, from <http://www.hc-sc.gc.ca/dhp-nps/marijuana/stat/index-eng.php>
- Jessop, J., & Garis, L. (2008). *Briefing note: Regulations to produce medical marijuana*. Minister of Public Safety, Ottawa, ON.
- Johnson, L. L., & Miller, J. D. (2012). Consequences of large-scale production of marijuana in residential buildings. *Indoor and Built Environment*, 21(4), 595-600.
- Julie, R. S. (2000). High-Tech Surveillance Tools and the Fourth Amendment: Reasonable Expectations of Privacy in the Technological Age. *Am. Crim. L. Rev.*, 37, 127.

- Kirkpatrick, S., Hanson, D., Fiecas, D., & Dandurand, Y. (2002). *Hydroponic Cultivation Equipment Outlets in British Columbia, Alberta, and Washington State*. Abbotsford, BC: University College of the Fraser Valley.
- LaBarge, A., & Noakes, K. (2005). *Indoor Marijuana Growing Operations*. *The Police Chief*, 7.
- Mallery, M. (2010). *Marijuana National Forest: Encroachment on California Public Land for Cannabis Cultivation*. *Berkeley Undergraduate Journal*, 23(2). doi: 1099-5331
- Malm, A. E. (2006). *Marijuana Cultivation in British Columbia: Using spatial and social network analysis techniques to inform evidence-based policy and planning*. (Doctor of Philosophy), Simon Fraser University, Burnaby, BC.
- Malm, A. E., & Tita, G. E. (2007). *A spatial analysis of green teams: a tactical response to marijuana production in British Columbia*. *Policy Sciences*, 39(4), 361-377. doi: 10.1007/s11077-006-9029-0
- McGallaghy, J., & McKeganey, N. (2013). *Does robust drug enforcement lead to an increase in drug users coming forward for treatment? Drugs: Education, Prevention, and Policy*, 20(1), 1-4. doi: 10.3109/09687637.2012.733980
- McKee, S. (2005). *Remote Sensing Issues at the Supreme Court of Canada*. *ACMLA*, 123, 3 - 6.
- McLaren, J., Swift, W., Dillon, P., & Ailsop, S. (2008). *Cannabis potency and contamination: a review of the literature*. *Addiction*, 103(7), 1100-1109. doi: 10.1111/j.1360-0443.2008.02230.x
- Moller, M., Koren, G., Karaskov, T., & Garcia-Bourmissen, F. (2011). *Examining the health and drug exposures among Canadian children residing in drug-producing homes*. *J Pediatr*, 159(5), 766-770 e761. doi: 10.1016/j.jpeds.2011.05.044
- Mulgrew, I. (2013, February 12). *B.C.'s civil forfeiture law has become a government cash grab*, Vancouver Sun. Retrieved from <http://www.vancouversun.com/news/Mulgrew+civil+forfeiture+become+government+cash+grab/7955719/story.html>
- Nguyen, H., & Bouchard, M. (2010). *Patterns of Youth Participation in Cannabis Cultivation*. *Journal of Drug Issues*, 40(2), 263-293. doi: 10.1177/002204261004000202
- Nguyen, H., & Bouchard, M. (2011). *Need, Connections, or Competence? Criminal Achievement among Adolescent Offenders*. *Justice Quarterly*, 30(1), 44-83. doi: 10.1080/07418825.2011.589398
- Picard, A. (2012, December 17). *Medical marijuana move angers health professionals*, Globe and Mail. Retrieved from <http://www.theglobeandmail.com/life/health-and-fitness/health/medical-marijuana-move-angers-health-professionals/article6469212/>
- Plaschke, B. J. (1993). *United States v. Deane: Thermal Imagery, the Latest Assault on the Fourth Amendment Right to Privacy*. *J. Marshall J. Computer & Info. L.*, 12, 607.
- Fiecas, D. (2007). *Research Note: Weapons Seized in Founded Indoor Marijuana Grow Operations in Single Family Dwellings in Surrey, British Columbia 1997 - 2006*. Abbotsford, BC: University of the Fraser Valley.
- Fiecas, D., Chaisson, K., & Garis, L. (2011). *The Nature and Extent of Marijuana Growing Operations in the Cariboo Region of British Columbia: A 14 Year Review (1997 - 2010)*. Abbotsford, BC: University of the Fraser Valley.
- Fiecas, D., Chaisson, K., Garis, L., & Snow, A. (2011). *The nature and extent of marijuana growing operations in Mission, British Columbia: A 14 year review (1997-2010)*. Abbotsford, BC: University of the Fraser Valley.
- Fiecas, D., Dandurand, Y., Chin, V., & Segger, T. (2002). *Marijuana Growing Operations in British Columbia: An Empirical Survey 1997 - 2000*. Abbotsford, BC: University College of the Fraser Valley.
- Fiecas, D., & Diplock, J. (2007). *Marijuana growing operations in Alberta: 1997 - 2004*. Abbotsford, BC: University College of the Fraser Valley.
- Fiecas, D., Diplock, J., & Garis, L. (2009). *Commercially Viable Indoor Marijuana Growing Operations in British Columbia: What Makes Them Such a Serious Issue?* Abbotsford, BC: University of the Fraser Valley.
- Fiecas, D., Diplock, J., & Garis, L. (2012). *Revisiting the Issues Around Commercially Viable Indoor Marijuana Growing Operations in British Columbia*. Abbotsford, BC: University of the Fraser Valley.
- Fiecas, D., & Malm, A. *The Connection Between Marijuana Growing Operations and House Fires in British Columbia*. Abbotsford, BC: University College of the Fraser Valley.
- Fiecas, D., Malm, A., & Kinney, B. (2005). *Marijuana growing operations in British Columbia revisited*. Abbotsford, BC: University College of the Fraser Valley.

- Potter, G., Gaines, L., & Holbrook, B. (1990). Blowing smoke: An evaluation of marijuana eradication in Kentucky. *American Journal of Police*, 9(1), 97 - 116.
- Royal Canadian Mounted Police. (2010). Report on the illicit drug situation in Canada - 2009. Ottawa, ON: Royal Canadian Mounted Police.
- Royal Canadian Mounted Police. (2011). Marijuana Grow Initiative - DRAFT.
- Royal Canadian Mounted Police. (2012). Marijuana Grow Initiative Annual Report 2012. Ottawa, ON.
- Schneider, S. (2004). Organized crime, money laundering, and the real estate market in Canada. *Journal of Property Research*, 21(2), 99-118. doi: 10.1080/0959991042000338801
- Stockwell, T., Sturge, J., Jones, W., Fischer, E., & Carter, C. (2006). Cannabis use in British Columbia: patterns of use, perceptions, and public opinion as assessed in the 2004 Canadian Addiction Survey. Victoria, BC: Centre for Addictions Research of BC.
- Stop the Violence BC. (2011). Breaking the Silence: Cannabis Prohibition, Organized Crime, and Gang Violence in BC. Vancouver, BC: Stop the Violence BC Coalition.
- Toonen, M., Ribot, S., & Thissen, J. (2006). Yield of illicit indoor cannabis cultivation in the Netherlands. *J Forensic Sci*, 51(5), 1050-1054. doi: 10.1111/j.1556-4029.2006.00228.x
- United Nations Office of Drugs and Crime. (2009). World Drug Report 2009. New York, NY: United Nations Publications.
- United Nations Office of Drugs and Crime. (2011). World Drug Report 2011. New York, NY: United Nations Publications.
- United Nations Office of Drugs and Crime. (2012). World Drug Report 2012. New York, NY: United Nations Publications.
- US Drug Enforcement Agency. (2013). 2012 Domestic Cannabis Eradication/Suppression Statistical Report. Retrieved June 27, 2013 from <http://www.justice.gov/dea/ops/cannabis.shtml>
- van Ours, J. C., & Williams, J. (2007). Cannabis prices and dynamics of cannabis use. *J Health Econ*, 26(3), 578-596. doi: 10.1016/j.jhealeco.2006.10.001
- White, T. M. (1995). Heat is On: The Warrantless Use of Infrared Surveillance to Detect Indoor Marijuana Cultivation, *The Ariz. St. L.*, 27, 295.
- Williams, J. (2004). The effects of price and policy on marijuana use: What can be learned from the Australian experience? *Health Economics*, 13, 123 - 137.

Cited Legislation

- Canada Consumer Product Safety Act, SC 2010, C-21 Stat.
- Civil Forfeiture Act, SBC 2005, C-29 Stat.
- Community Safety Act, Bill 12, Legislative Assembly of the Province of British Columbia (2013).
- Controlled Drugs and Substances Act, SC 1996, C-19 Stat.
- Environmental Management Act, RSBC 2003 C-53 Stat.
- Freedom of Information and Protection of Privacy Act, RSBC 1996, C-165 Stat.
- Safety Standards Amendment Act, Bill 25, Legislative Assembly of the Province of British Columbia (2006).

Uncited Recommended Sources

- Bouchard, M., & Nguyen, H. (2010). Is It Who You Know, or How Many That Counts? Criminal Networks and Cost Avoidance in a Sample of Young Offenders. *Justice Quarterly*, 27(1), 130-158. doi: 10.1080/07418820802593386
- Boyd, S., & Carter, C. (2012). Using Children: Marijuana Grow-ops, Media, and Policy. *Critical Studies in Media Communication*, 29(3), 238-257. doi: 10.1080/15295036.2011.603133
- Gustin, E. (2010). The Hazards of Grow Houses. *Fire Engineering*, 163(6), 69-71.
- Hakkaraimein, P., Frank, V. A., Perala, J., & Dahl, H. V. (2011). Small-scale cannabis growers in Denmark and Finland. *Eur Addict Res*, 17(3), 119-128. doi: 10.1159/000322920
- Hough, M., Warburton, H., Few, B., May, T., Man, L-H., Witton, J., & Turnbull, P. J. (2003). A Growing Market: The Domestic Cultivation of Cannabis. York, UK: Joseph Roundtree Foundation.

- Kalaska, M., & Bouchard, M. (2011). Using police seizure data and hyperspectral imagery to estimate the size of an outdoor cannabis industry. *Police Practice and Research*, 12(5), 424-434. doi: 10.1080/15614263.2010.536722
- Knight, G., Hansen, S., Connor, M., Poulsen, H., McGovern, C., & Stacey, J. (2010). The results of an experimental indoor hydroponic Cannabis growing study, using the 'Screen of Green' (ScrOG) method-Yield, tetrahydrocannabinol (THC) and DNA analysis. *Forensic Sci Int*, 202(1-3), 36-44. doi: 10.1016/j.forsciint.2010.04.022
- Korf, D. J., Benschop, A., & Wouters, M. (2007). Differential responses to cannabis potency: a typology of users based on self-reported consumption behaviour. *Int J Drug Policy*, 18(3), 168-176. doi: 10.1016/j.drugpo.2006.08.002
- Malm, A., & Eichler, G. (2011). Networks of Collaborating Criminals: Assessing the Structural Vulnerability of Drug Markets. *Journal of Research in Crime and Delinquency*, 48(2), 271-297. doi: 10.1177/0022427810391535
- Malm, A. E., Kinney, J. B., & Pollard, N. R. (2008). Social Network and Distance Correlates of Criminal Associates Involved in Illicit Drug Production. *Security Journal*, 21(1-2), 77-94. doi: 10.1057/palgrave.sj.8350069
- Piecas, D., Diplock, J., Garis, L., Carlisle, B., Neal, F., & Landry, S. (2009). *The Marijuana Indoor Production Calculator: A Tool for Estimating Domestic and Export Production Levels and Values*. Abbotsford, BC: University of the Fraser Valley.
- Potter, D. J., & Duncombe, P. (2012). The effect of electrical lighting power and irradiance on indoor-grown cannabis potency and yield. *J Forensic Sci*, 57(3), 618-622. doi: 10.1111/j.1556-4029.2011.02024.x
- Potter, G. (2008). *The growth of cannabis cultivation: explanations for import substitution in the UK*. In D. Korf (Ed.), *Cannabis in Europe: Dynamics in Perception, Policy and Markets*. Pabst: Lengerich.
- Royal Canadian Mounted Police. (2007). *Drug situation in Canada - 2007*. Ottawa, ON: Royal Canadian Mounted Police.
- Weisheit, R. A. (1991). The intangible rewards from crime: The case of domestic marijuana cultivation. *Crime & Delinquency*, 37(4), 506-527.
- Weisheit, R. A. (1993). Studying Drugs in Rural Areas: Notes from the Field. *Journal of Research in Crime and Delinquency*, 30(2), 213-232. doi: 10.1177/0022427893030002005
- Wilkins, C., & Casswell, S. (2003). Organized crime in cannabis cultivation in New Zealand: an economic analysis.pdf. *Contemporary Drug Problems*, 30, 757 - 777.

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Appendix J: Residential Tenancy Act Excerpt

Excerpt from: British Columbia, *Residential Tenancy Act* [SBC 2002] Chapter 78. Available at: http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/00_02078_01#section29

Please refer to sections 29(1)(f) and 29(2).

Landlord's right to enter rental unit restricted

Section 29

(1) A landlord must not enter a rental unit that is subject to a tenancy agreement for any purpose unless one of the following applies:

(a) the tenant gives permission at the time of the entry or not more than 30 days before the entry;

(b) at least 24 hours and not more than 30 days before the entry, the landlord gives the tenant written notice that includes the following information:

(i) the purpose for entering, which must be reasonable;

(ii) the date and the time of the entry, which must be between 8 a.m. and 9 p.m. unless the tenant otherwise agrees;

(c) the landlord provides housekeeping or related services under the terms of a written tenancy agreement and the entry is for that purpose and in accordance with those terms;

(d) the landlord has an order of the director authorizing the entry;

(e) the tenant has abandoned the rental unit;

(f) an emergency exists and the entry is necessary to protect life or property.

(2) A landlord may inspect a rental unit monthly in accordance with subsection (1) (b).