Building an Industrial Hemp Industry in Minnesota 1 Building an Industrial Hemp Industry in Minnesota Building an Industrial Hemp Industry in Minnesota 2 Foreword 4 Overview 18 Minnesota Opportunities 25 Profile: Strohfus 26 Food Landscape 38 Profile: Healthy Oil Seeds 37 Biobased Lsndscape 46 Profile: c2renew 47 Profile: Hemp Acres LLC 48 CBD Oil Landscape 54 Feed and Coproducts Landscape 60 Renewable Energy Landscape 66 Resources 68 Conclusions Building an Industrial Hemp Industry in Minnesota 3 FOREWORD Minnesota Hemp Value Chain Analysis AURI is pleased to present this Minnesota Hemp Value Chain Analysis report to the growers, government, supply chain sectors and end users who are engaged in the emerging hemp industry in Minnesota. With the interest in industrial hemp growing both nationally and internationally, along with the passage of the U.S. 2018 Farm Bill allowing cultivation of the crop, AURI decided to create this comprehensive report, which provides an overview of the industrial hemp industry. The report provides a summary of the primary value-add opportunities for hemp in Minnesota, including food, fiber, CBD, fuel and feed. Additionally, the report discusses the challenges that lie ahead in connecting growers and end users to the processing infrastructure to deliver value-added products to the marketplace. AURI would like to thank the growers, state officials, industry value chain experts and scientific professionals who contributed to this report. AURI is committed to working with the hemp industry by providing value-added ag research, laboratory analysis, business and technical services, and a network of science and business professionals. Please connect with us via our website at: www.auri.org. Building an Industrial Hemp Industry in Minnesota Building an Industrial Hemp Industry in Minnesota 4 OVERVIEW HISTORY OF INDUSTRIAL HEMP Until the recent passing of the 2018 Farm Bill, or Agriculture Improvements Act of 2018 production of industrial hemp within the United States was limited by regulatory restrictions due to its association with marijuana.3 With the passing of this bill, hemp has been officially reclassified for commercial use, distinguishing the crop from marijuana and removing it from the Controlled Substances Act.4 Because of the limitations in place prior to this passage, however, the market for industrial hemp in the United States has been primarily dependent upon imports from countries with an established industry.3 Contrary to marijuana, industrial hemp (Cannabis sativa L), contains no more than 0.3 percent delta-9 tetrahydrocannabinol (THC). Grown for industrial, non-drug purposes, the crop lends itself for use in a large variety of products including, but not limited to, agricultural, textiles, automotive parts, furniture, food and beverages, paper, construction materials and personal care items.2 The hemp industry has not always faced such strict regulations. Hemp was believed to have been brought to North America in 16065, where it was grown primarily for fiber as a cash crop in settlements in Canada and the United States.3 The market ultimately began to suffer due to the development of synthetic fibers such as nylon, as well as the improvement of technology for making paper from trees.6 Regulatory action also had a significant impact. “ PRODUCTS INCLUDING, BUT NOT LIMITED TO, TEXTILES, AUTOMOTIVE PARTS, FURNITURE, FOOD AND BEVERAGES, PAPER, CONSTRUCTION MATERIALS AND PERSONAL CARE ITEMS. ” Building an Industrial Hemp Industry in Minnesota 5 Source: “The State of Hemp: 2014-2022,” New Frontier Data derived from Hemp Business Journal1 In the early 1900s, there was an effort to ban marijuana and hemp, beginning with the outlawing of the THC-containing component in several states. The Harrison Act of 1914 defined the use of marijuana as a crime and, by 1915, California had become the first state to ban the crop. Confusion surrounding the issue arose with the 18th Amendment to the U.S. Constitution in 1919, suggesting the drug as an attractive alternative to alcohol as the prohibition era began. Nonetheless, following the statewide ban in California, 28 additional states adopted this restriction by 1929.7,8 In 1937, Congress passed the Marihuana Tax Act, which effectively began the era of industrial hemp prohibition. The tax and licensing regulations of the Act defined it as a narcotic drug and made hemp cultivation difficult for American farmers.9 As a result, farmers were required to hold a federal registration and special tax stamp to continue growing the crop.3 While this did create a more regulated market, it did not cause a decline in hemp production on an immediate basis. Global events weighed in next. The Japanese attack on Pearl Harbor ended foreign supplies of “manila hemp” fiber from the Philippines. The U.S. government formed the War Hemp Industries Department and subsidized hemp cultivation, producing a film called “Hemp for Victory” to encourage U.S. farmers to grow hemp. During the war, U.S. farmers grew approximately a million acres of hemp across the Midwest as part of that program. After a product peak in 1943, hemp production began its steady

decline, eventually ceasing to exist to any magnitude in the United States.6 Following the war, the government quietly shut down all hemp processing plants and the industry faded away again.9 The crop was not entirely ignored, however. From 1937 through the 1960s, the U.S. government acknowledged that industrial hemp and marijuana were distinct varieties of the cannabis plant. This changed when hemp was no longer officially recognized as distinct from marijuana after passage of the Controlled Substances Act (CSA) of 1970. This occurred despite the fact that a specific exemption for hemp was included in the CSA under the definition of marijuana. The recent federal court case HIA vs. DEA has reestablished acknowledgement of distinct varieties of cannabis and supported the exemption for non-viable seed and fiber, as well as any products made from them.9 USES FOR HEMP INDUSTRIAL TEXTILES • Twine & Rope • Nets • Canvas & Tarps • Caulk • Carpets • Brake/Clutch Linings • Argo-Fiber Composite & Molded Parts • Geo-Textiles • Printing Paper • Fine/Speciality Paper • Filter Paper • Newsprint • Cardboard/Packaging PAPER • Boiler Fuel • Pyrolysis Feedstock ENTIRE PLANT • Animal Bedding • Mulch & Compost HURDS (PULP) • Oils • Isolates • Distillates EXTRACTS HEMPSEED OILBAST FIBERS • Abrasive Chemicals CELL FLUID • Fiberboard • Insulation • Fiberglass Substitute • Cement • Stucco & Mortar BUILDING MATERIALS • Salad Oil • Margarine • Food Supplements (Vitamins) • Cooking Oils FOODS (OILS) • Granola • Birdseed • Cereal • Bars • Protein Powder • Animal Feed • Protein-rich Fiber FOODS (SEED & SEED CAKE) • Car Parts • Bioplastics • Scooters • Semiconductors • Oil Paints & Varnishes • Printing Inks • Fuel • Solvents • Lubricants • Putty • Coatings INDUSTRIAL PRODUCTS • Soap • Shampoo • Bath Gels • Cosmetics • Lotions • Balms PERSONAL HYGIENE CONSUMER TEXTILES • Apparel • Diapers • Fabrics • Denim • Fine Fabrics • Handbags • Shoes HEMP PLANT SEEDSTALK LEAVES FLOWER Building an Industrial Hemp Industry in Minnesota Building an Industrial Hemp Industry in Minnesota 6 While strict regulations dramatically impeded industrial hemp growth in the United States, many other countries did not face such obstructions. In fact, hemp grows naturally throughout Central Asia and has been a part of many cultures' history, being traced to as early as 2700 BC in ancient Chinese writings as well as in ancient tombs. Hemp production in foreign countries continued to evolve over the years, allowing for further advancements in processing and development of the industry. Since the Second World War, the main areas of hemp production have been India, China, Germany, Hungary, Poland, England, Holland and France.6 Today, roughly 30 countries grow and export hemp, with China at the forefront. In fact, approximately 20 percent of global production of industrial hemp can be credited to China. Because the cultivation and export markets of these countries continued while the United States restricted production, some questioned whether the U.S. could competitively re-enter this market. Even Canada, while following similar regulatory policies of the United States for some time, now represents a far more established market.2 [A list of countries that produce and export hemp can be found on the National Hemp Association website.10] The growth of competition has not discouraged industrial hemp advocates. In 1994, Canada began issuing licenses to allow research on industrial hemp. Beginning as early as 1999, the United States began to pass laws governing hemp cultivation, assisted by the support of the American Farm Bureau Federation.11 Prior to the 2018 Farm Bill, 41 states had passed legislation related to industrial hemp, such as defining hemp and removing barriers, and 39 states permitted hemp cultivation and production programs.12 As a result, interest in industrial hemp as a cash crop resurfaced in several states. Both economic and market studies were conducted and used as catalysts to initiate or enact legislation to expand resources and production at the state level. In the 109th Congress, the Industrial Hemp Farming Act was first introduced. This has since been expanded upon, recently achieving the ultimate goal of expediting hemp production in the United States and amending the Controlled Substances Act (CSA) to no longer include industrial hemp under the marijuana umbrella definition.3 Even though domestic hemp production faced restrictions over the years in the United States, there has been an active movement to legalize industrial hemp production over the past two decades.13 Hemp advocacy made large gains in 2014, when the newly passed farm bill allowed research institutions and state departments of agriculture to grow the crop under an agricultural pilot program. The bill declared that industrial hemp could not contain a concentration of tetrahydrocannabinol (THC) that exceeded 0.3 percent on a "dry weight basis." This bill did not eliminate all regulations, however. Certain aspects of industrial hemp production were still subject to oversight from the Drug Enforcement Agency (DEA), including importing seeds, which required

registration under the Controlled Substances Import and Export Act.3 Nonetheless, with the passing of the 2018 Farm Bill, regulation and enforcement of this crop has been moved from the DEA to the USDA.4 Even though hemp was still classified as a Schedule 1 controlled substance under the CSA, section 7606 of the U.S. Agricultural Act of 2014 legalized state departments of agriculture and certain research institutions to grow hemp via pilot programs for research purposes. Colorado and Kentucky were especially known for their pilot programs with planted acres at 5,922 and 2,525 acres, respectively, in 2016.13 Building an Industrial Hemp Industry in Minnesota 7 Source: PanXchange Hemp Report, 201914 Nationally, 32 states15 allowed hemp production per the 2014 Farm Bill. Vote Hemp — a Washington D.C.-based grassroots nonprofit organization working to bring back hemp farming in the U.S. — estimated that in 2015, 9,650 acres of hemp were planted in 15 states, 30 universities conducted hemp-related research and 817 state hemp licenses were issued. The status of state hemp production and legislation by state as of 2018 is shown above. Concerns have been expressed by the DEA that legalization efforts for industrial hemp could be a front for those advocating for the decriminalization of marijuana, and could complicate surveillance and enforcement efforts.2 Nonetheless, this crop is no longer restricted due to its relation to marijuana, which remains under the Controlled Substances Act. While there is enthusiasm surrounding the potential economic benefits that industrial hemp could bring, some experts say that this could be a common reaction to the possibility of a “new, novel” crop. Throughout the past 50 years, optimism surrounding several crops has surfaced and subsequently subsided based upon unfulfilled expectations.11 Industrial hemp has the capacity to produce a broad variety of both industrial and consumer products. Many experts say, however, that the controversy surrounding the crop has overshadowed progress.16 • State with hemp production • State with enacted hemp legislation • State without enacted hemp legislation 2018 STATE OF HEMP INDUSTRY Building an Industrial Hemp Industry in Minnesota Building an Industrial Hemp Industry in Minnesota 8 RECENT CHANGES The 2018 Farm Bill, which went into effect January 1, 2019, sets the stage for greater expansion in an industry already seeing explosive growth. According to industry experts at New Frontier Data, a cannabis market research firm, federal legalization could triple the overall hemp market to $2.5 billion by 2022, with $1.3 billion of those sales from hemp-derived CBD products.17 “It’s a huge deal because it’s a domino effect. Banks can get involved now and, if banks get involved, then credit card processors get involved – and, if that happens, then big box stores like Target and Walmart get into it,” said Sean Murphy, a data analyst who has tracked the industry since its infancy in 2015. “All these big players are going to come in.”17 The farm bill does not open all doors to hemp commerce, however. There are still restrictions. Hemp cannot contain more than 0.3 percent THC. Secondly, there will be significant, shared state-federal regulatory framework for hemp cultivation and production. State departments of agriculture must consult with the state’s governor and chief law enforcement officer to devise a plan and submit it to the USDA. Licensing and regulating hemp will begin once plans are approved.18 Hemp farmers will eventually be able to buy crop insurance, apply for loans and grants, and write off their business expenses on their taxes like any other crop. Those who sell dried flower or CBD- infused products made from hemp can now ship across state lines without fear of prosecution, as long as they are in compliance with the U.S. Food and Drug Administration. Also, Section 12619 of the farm bill removes hemp-derived products from its Schedule I status under the Controlled Substances Act, but the legislation does not legalize CBD in general.17 ENVIRONMENTAL BENEFITS One of the many documented attractions of industrial hemp is the environmental benefits it can provide. In comparison to some other crops, industrial hemp does not deplete the soil of nutrients as quickly. It has been reported that hemp can return up to as much as 60 percent of the nutrients it detracts from the soil. A Kentucky report stated industrial hemp was grown on the same land for 14 consecutive years before soil depletion or a reduced yield occurred.19 Planting hemp on hemp over time like this, however, can lead to diseases taking over and reducing yields. While this crop has low requirements regarding crop rotations, it can also contribute to healthier soil for other crops.20 In fact, hemp has even been referred to as a “pioneer plant,” meaning it can be used for land reclamation.20 With a deep rooting system, the hemp plant provides soil aeration and fertilization, leaving optimal conditions for the next crop.11 In a study conducted in 1999, hemp along with many other crops were tested and ranked for their “biodiversity friendliness.” Hemp for both seeds and fiber ranked among the top five crops, outperforming major crops including wheat, maize and rapeseed.20

Hemp plants provide significant shade, limiting weed growth. Because of this, and the natural disease resistance of the plant, industrial hemp can technically be grown without the use of herbicides, pesticides or fungicides — making this an easy crop to comply with organic farming requirements.20 In addition to being a relatively beneficial crop to the land on which it is planted, products made with hemp are found to be more efficient and less taxing on the environment. Over a 20-year timespan, one acre of hemp can produce as much pulp for paper as roughly four acres of trees. Building an Industrial Hemp Industry in Minnesota 9 FIGURE 1: CRUDE MEAN EVALUATION OF BIODIVERSITY FRIENDLINESS OF SELECTED MAJOR CROPS AND FIBRE CANNABIS Source: Monford and Small, 1999 Hemp paper can also be recycled up to seven or eight times, as opposed to the typical three times with wood pulp paper. With higher production and recycling rates, industrial hemp could play a key role in reducing deforestation, while creating more durable and environmentally friendly paper.19 Paper is not the only industry that could benefit from regular access to industrial hemp crops. Hemp fibers are lightweight with a higher than average weight-to-strength ratio.11 Hemp fiber also has very high insulating potential, offering a “greener” solution than currently used raw materials.16 When compared to cotton, one acre of industrial hemp can produce two to three times the fiber from the same area of land. Additionally, the fiber produced from hemp breathes and is recyclable, unlike petroleum-based fibers.19 Another significant environmental benefit of industrial hemp is the production of biomass for renewable fuels, which could reduce dependency on fossil fuels. Biomass fuels offer an alternative to fossil fuels, eliminating the release of sulfur oxides into the atmosphere. Not only does biomass provide a cleaner alternative, it could be more efficient when considering hemp is the leading crop of biomass production per acre.19 With respect to other oil seeds, hemp is fairly mid-range in terms of oil content at around 30 percent. Second only to whale oil in quality, hemp seed oil has similar burning qualities to that of heating oil, while avoiding sulfur-based pollutants.19 With more emphasis on utilizing renewable resources such as these, industries could consider transitioning away from dependence upon fast-disappearing resources and begin building sustainable, environmentally friendly economies and products.16 Alfalfa Timber trees Oilseed Cannabis Ginseng Fibre Cannabis Apple Peanut Grape Flax Corn (maize) Wheat Soybean Rye Sunflower Potato Sorghum Cotton Sugar cane Rice Rapeseed (canola) Barley Oats Tobacco Increasing Biodiversity Friendliness Building an Industrial Hemp Industry in Minnesota Building an Industrial Hemp Industry in Minnesota 10 PRODUCTION Potential yields and processing methods, along with the cost and return of growing hemp, are important considerations when evaluating it as a potential U.S. crop. Revenue is dependent upon yields and market prices. Generally, the lower the market price, the greater the yield must be for producers to break even or make a profit.20 Industrial hemp is a member of the Cannabaceae family, as is marijuana.6 However, production, development and uses of industrial hemp have taken a largely different path through years of cultivation. Beginning with the enactment of the 2014 Farm Bill, growing hemp was once again permitted in the United States under restricted circumstances.3 Some research institutions and state departments of agriculture began growing the crop and, as of 2017, there were reported to be more than 25,000 acres of hemp production in the United States — up from just 9,770 acres in 2016. There were 1,420 registered or licensed growers, and more than 30 universities nationwide conducting research. As production increases so does the need for proper processing facilities. Currently, several states incentivize investments in processing capacity, including Kentucky, Tennessee, North Carolina and New York.3 Some still question whether hemp fibers can be profitably processed in the United States. The technologies used to process hemp fiber have not changed much, and require capital investment and knowledgeable workers. Research is underway to streamline harvesting, retting and fiber separation, but those technological breakthroughs have yet to occur. Source: National Hemp Association21 U.S. INDUSTRIAL HEMP STATUS BY STATE as of August, 2017 2019 AURI HEMP ACTIVITY MAP • Allows Commercial Production • Research/Limited Commercial Activity • Pending Hemp Legislation • No Hemp Legislation Building an Industrial Hemp Industry in Minnesota 11 Traditional retting and fiber-separation processes — both labor and resource intensive — could limit the ability of U.S. hemp producers to compete against major suppliers such as China, Hungary, Poland and Romania.20 Technological advancements in production and processing have not necessarily carried over to the hemp industry. For example, developments made in the wood pulping process vary greatly from those relevant to the hemp plant. Wood fiber is dense and can be

transported long distances, whereas hemp fiber is lightweight and cannot be economically transported over long distances. Currently, there are several new lab scale processes being tested for hemp pulp that are yet to be implemented for commercial businesses. The success of the industry not only depends upon the implementation of these advancements at the processing level, but also on the development of the market for these fibers.6 As Ken Anderson of Prescott, Wisconsin, who operates Legacy Hemp in Minnesota, Wisconsin, Kentucky and North Dakota, observed in The Land Online, "There is a need to expand the market so more American farmers can grow hemp . . . The better job that we do of expanding the market, the sooner it will be that it (hemp) will be treated as a commodity. Right now, it's not the reality," he said. "If you grow, you better know who your buyer is at the end of the day."22 2019 AURI HEMP ACTIVITY MAP • Food Processing Locations • Fiber Processing Locations • CBD Processing Locations • Equipment Manufacturers C – Cleaning Equipment/Services P – Processing Equipment H – Harvesting Equipment P Food Processing Locations Fiber Processing Locations CBD Processing Locations Equipment Manufacturers C – Cleaning Equipment/Services P – Processing Equipment H – Harvesting Equipment Hemp Activity Map P H C C PC | P PP Building an Industrial Hemp Industry in Minnesota Building an Industrial Hemp Industry in Minnesota 12 Source: North Dakota State University23 HARVEST AND STORAGE Hemp is a venerable, versatile crop.22 Historically, there have been many uses for this plant species; however, there are currently two variations that have the potential to make it a thriving cash crop in today's world. Hemp plants can be used for both its fiber (from stalks) and seeds. The fibrous stalks offer an environmentally friendly alternative to a large variety of products, including insulation and paper, while the seeds produce oils that are increasingly popular in the food industry, personal care products and pharmaceuticals, as well as for a potential replacement for fossil fuels. Although both the fiber and seeds come from the same plant, aspects of the planting and harvesting process are different depending upon the intended use of the crop.6 For fiber crops, seeds are planted closer together to promote height, while preventing branching out and flowering.2 This plant is also light sensitive, so early plantings will yield taller, more desirable output. The taller the crop, the more fiber produced; this is ideal considering fiber makes up only 25 to 35 percent of stem dry matter.6 The growth and production process required for hemp used for fiber differs from that of hemp utilized for oilseed.11 Processing of the crop is therefore driven by end use. Processors of hemp seed, for instance, desire raw material that is of good food-grade quality; dry and sound; and meets acceptable standards for variety, color and appearance, flavor, purity, grade, toxins and moisture. Industrial hemp can also be intended for use within the categories of grain, fiber and dual purpose (grain and fiber). Processing – and eventually harvest and storage practices – will vary depending upon final use.24 INDUSTRIAL HEMP • Food • Fiber Board • Compost • Mortar • Paper Filler • Absorbent Bedding • Chemical Feedstocks • Plastics • Paint • Sealant •Flour • Food • Fuel • Paint • Personal- Care Products • Food • Beer • Feed • Cordage Bagging • Fiber Board • Cordage • Pulp • Recycling Additive • Fabric • Insulation • Carpeting • Paneling HULLING HEMP SEEDS HARVEST INTERMEDIATE PROCESSING FURTHER PROCESSING SCUTCHING HACKLING MEAT SHELL OIL CAKE FIBER HURDS PRIMARY SECONDARY TOW HEMP STALKS PRESSING/CRUSHING DECORTICATING Building an Industrial Hemp Industry in Minnesota 13 The fiber is typically ready to harvest when the first seeds begin to develop. If left much past this point, the fiber will get too coarse.6 In the process of harvesting, the stems cannot be broken up or chopped if producing long fibers is the desired result. The outside tissue of the plant must be removed, and the fibers softened through a process called retting, in preparation for separation.2 Photo of Tall Fiber Crop Source: Alberta Agriculture and Forestry24 There are different types of retting that can be done, depending upon the end use of the fibers. At the time the hemp stalks are baled, the moisture content must be below 15 percent. As the stalks continue to dry through the processing stages, the moisture content must eventually reach levels of 10 percent or less. Currently, there is no existing equipment made specifically for harvesting hemp for fiber in the United States. This poses another obstacle that must be overcome as interest in developing a profitable industrial hemp industry increases.2 Unlike hemp intended for fiber production, flowering and branching are desirable for hemp crops with the end goal of seed production.2 Male plants die shortly after the flowering stage, leaving only the female and monoecious plants as seed producers. A monoecious plant can be defined as a plant with both male and female flowers. It is not a genetically stable plant and requires ongoing maintenance from the plant

breeders, making for a very hands-on crop. Hemp that is intended to produce seeds as an end product is harvested much later in the season than those used for fiber. This harvest begins approximately six weeks after flowering occurs. Fiber from the stalks that is grown specifically for seed production is stiff, brittle and coarse, ultimately limiting its use.6 Hemp can be harvested using a combine, but not without challenges. The resin is sticky and the hemp stalks are easily wound around moving parts, causing a need for a cleaning process after harvest. To store hemp seeds, proper aeration is required. Seeds can quickly overheat and are highly susceptible to damage. Damage to seed coat can be minimized if seed is unloaded slowly and cautiously. Similar to the fiber crop, hemp seed must be properly dried before being stored – ideally reaching a moisture content of eight to nine percent.2 There are numerous factors to be taken into consideration during the growth and production stages. One significant threat to hemp seed production in the United States is birds. Temperature is also a factor. Hemp can tolerate mild frost down to 23°F for a short period without harm to mature seeds or crop growth. A killing frost can hasten maturity and harvest is recommended within a few days to prevent yield loss and difficulties due to dry stem fiber. For taller, later-maturing hemp varieties, frost can be desirable, as it can help expedite harvesting. While the harvesting process varies depending upon the end use of the crop, ideal conditions prior to planting are similar. Industrial hemp plants prefer semi-humid conditions with air temperatures averaging between 60 and 80°F. During the first six weeks of cultivation, the crop needs water. Hemp has higher demands for water and nutrients than that of grain crops. Although hemp crops are drought resistant a mere few weeks after planting, a lack of initial moisture can greatly reduce the mass produced by the plant as well as the maturity levels reached.6 Building an Industrial Hemp Industry in Minnesota Building an Industrial Hemp Industry in Minnesota 14 This crop does best in well-drained loam soils versus heavy soils. The nutrient requirements are similar to that of corn, and a lack of nitrogen in the soil can severely reduce fiber production.6 Like most crops, proper planting conditions and maintenance throughout the growing season impact overall yield and production.24 ECONOMICS Industrial hemp can be utilized in a wide variety of products, with approximately 25,000 currently in market.3 Hemp-derived oil, or CBD, is quickly gaining popularity as a potential new method to treating a vast range of medical ailments. Various market research groups estimate the market value for this type of oil will range from $646 million to $22 billion by 2022. 1, 76 While sales data can be used to identify the contribution of hemp products to the retail industry, there is very little information from other sectors. Statistics on hemp use in construction, biofuels and other manufacturing uses, for instance, are not widely available.3 Source: “The State of Hemp: 2014-2022,” New Frontier Data derived from Hemp Business Journal1 Import statistics from 2017 show nearly two-thirds of U.S. hemp imports were hemp seeds, used mostly as ingredients of hemp-based products. Hemp imports totaled $67.3 million in 2017 and, while this was not an all-time high, U.S. hemp imports have shown a steady increase since 2005.3 While economic data is limited due to the early stages of industry development within the United States, current data reflects growth in U.S. hemp retail sales, suggesting an increase in demand.2 This may imply a promising economic outlook for the crop, supported by studies conducted by researchers in Canada as well as several state agencies. Rising acceptance for hemp and CBD – combined with easing regulations at the state level – caused U.S. hemp production to surge in 2017. From 2016 to 2017, the number of hemp acres in the U.S. increased by 166 percent, while the number of state hemp licenses issued grew by 78 percent over the same one-year period.25 The U.S. hemp industry grew 16 percent in 2017 amidst continued domestic legal and regulatory challenges – a landscape that is mollifying by the day – with the growth led by hemp-derived CBD, food, personal care and industrial products. In fact, as legal and regulatory barriers are removed and consumer education spreads, Hemp Business Journal estimates the U.S. hemp industry will grow to $1.9 billion.1 $1.9 BILLION U.S. HEMP-BASED PRODUCT SALES BY CATEGORY IN 2022E Food Hemp-Derived CBD Supplements Personal Care Consumer Textiles Other Consumer Products Industrial Applications $212 $646 $54 $259 $183 $23 $527 $ millions in consumer sales 0 100 200 300 400 500 600 700 Building an Industrial Hemp Industry in Minnesota 15 Total sales for the U.S. hemp industry in 2017 were $820 million. The top three product categories that contributed to this total are hemp-derived CBD products at $190 million, personal care products at $181 million and industrial applications reporting $144 million. The remaining total included food, supplements, consumer textiles and other consumer goods.1 $820 MILLION U.S. HEMP-BASED PRODUCT SALES BY CATEGORY IN 2017 $ millions in

consumer sales Source: “The State of Hemp: 2014-2022,” New Frontier Data derived from Hemp Business Journal1 INDUSTRIAL APPLICATIONS 18% | $144 OTHER CONSUMER PRODUCTS 2% | $16 CONSUMER TEXTILES 13% | $105 PERSONAL CARE 22% | $181 SUPPLEMENTS 5% | $45 HEMP CBD 23% | $190 FOOD 17% | $137 Building an Industrial Hemp Industry in Minnesota Building an Industrial Hemp Industry in Minnesota 16 SUPPLY CHAIN As noted, it is no secret that hemp has an impressive list of uses. The fibers can be incorporated in fabrics and textiles, yarns and spun fibers, paper, carpeting, home furnishings, construction and insulation materials, auto parts and composites. Hurds, another material derived from the stalk, are used in building materials, papermaking and oil absorbents. Hemp seed and oilcakes contribute to a range of foods and beverages, and can provide an alternative source of protein for feed. Oil from the hemp seed is used in a range of body products and cosmetics. MODERN USES OF INDUSTRIAL HEMP Source: Vote Hemp, Inc., September 201816 Hemp can also be found in nutritional supplements and medicinal products, including pharmaceuticals. It can be used in composite products such as “hempcrete,” a hemp-based alternative to concrete; insulation; hemp plastics; and fiberglass alternatives.3 BAST FIBER HURD (WOODY CORE) SEED CAKE (AFTER PRESSING) HEMP OIL WHOLE STALK HEMP SEED TEXTILES • Apparel • Fabrics • Bags • Shoes • Socks BUILDING MATERIALS • Fiberboard • Insulation • Hempcrete FOODS • Breads • Granola • Ice Cream • Milk • Cereals • Protein Powder FOODS • Salad Oils • EFA Food Supplements • Margarine • Saute Oils BODY CARE • Soaps • Shampoos • Hand Creams • Cosmetics • Lip Balms TECHNICAL PRODUCTS • Oils • Paints • Solvents • Varnishes • Lubricants • Inks • Diesel Fuel • Coatings HEMP NUT FOODS • Animal Feed • Protein-Rich Flour ENERGY & ENVIRONMENTAL PRODUCTS • Ethanol/Biofuels • Erosion Control Blankets INDUSTRIAL PRODUCTS • Animal Bedding • Mulch • Boiler Fuel • Chemical Absorbent PAPER • Printing • Cigarette • Filters • Newsprint • Packaging • Cardboard TECHNICAL TEXTILES • Cordage • Netting • Canvas • Carpeting NEW USE INDUSTRIAL PRODUCTS • Geotextiles • Biochemicals • Non-Wovens • Pultrusion • Compression • Molding Building an Industrial Hemp Industry in Minnesota 17 Because of the evolving government regulations regarding growth and transportation, entry into the hemp industry is still a somewhat complicated and unclear process. Currently, hemp processing is unable to keep up with investor and consumer enthusiasm for the crop.19 While this industry is in the early stages of development, there arises an increasing need for a full supply chain to bring this crop from field to market. Lingering uncertainty surrounding regulatory issues, supply and demand, and profitability have impacted industry growth, however. In Minnesota, hemp growers have pointed to difficulties in processing delays and regulatory confusion, as well as natural pests. These barriers have not greatly discouraged the small and growing hemp industry in Minnesota. Producers of the crop have expressed interest in developing this industry further for the variety of uses mentioned above, and optimism and enthusiasm about the potential for a profitable industry continue.19 Unfortunately, the enthusiasm and motivation of growers is still met with a lack of processors within the state.19 With the 2018 Farm Bill, opportunely, transporting the crop between states for commercial production is now legal along with interstate commerce.26 Attention is needed to develop this emerging industry supply chain from field to consumer. Building an Industrial Hemp Industry in Minnesota Building an Industrial Hemp Industry in Minnesota 18 MINNESOTA OPPORTUNITIES Minnesota hemp production has grown dramatically thanks to industry interest, introduction of a successful pilot program and a geographical latitude favorable to varieties already successful in Canada. While growers in the state report processing delays, pest issues and legal/regulatory challenges, enthusiasm for establishing a profitable industry has grown.27 But, as an article by StarTribune reporter, Jennifer Brooks, noted, “There’s a steep learning curve when you’re resuscitating an industry that’s been dormant in this state for six decades.”28 MINNESOTA HEMP SNAPSHOT AS OF DECEMBER 2017 . . . . . Licensed Growers: 38 . . . . . Licensed Processors: 0** 2,000 outdoor acres . . . . . Products allowed: There are no formal rules, but hemp is reported to be grown for CBD extraction, seed or seed oil and fiber . . . . . ** Minnesota does not require processing licenses Source: Hemp Industry Daily, 201819 “ WHEN HEMP IS NO LONGER A CONTROLLED SUBSTANCE, IT CAN BECOME A TRADED

COMMODITY. ” - Ken Anderson, Legacy Hemp Building an Industrial Hemp Industry in Minnesota 19 A COMPLEX ENVIRONMENT Hemp and marijuana may look similar – a factor that has slowed industry growth. Visual appearance is where the similarities end, however, yet both have been caught in a legal tug of war. The regulatory environment for hemp is complex, controversial and changing literally by the day. Hemp is used in thousands of products spanning multiple manufacturing and retail industries, thanks in part to state legislatures promoting industrial hemp as an agricultural commodity in recent years. President Obama signed the Agricultural Act (or Farm Bill) of 2014, which included Section 7606 allowing for universities and state departments of agriculture to grow or cultivate industrial hemp within an agricultural pilot program or other agricultural or academic research; and if such is allowed under state laws in which “the institution of higher education or state department of agriculture is located, and such research occurs.” The law required growers to be certified and registered at the state level. It must be noted, however, that the federal Controlled Substances Act previously did not recognize a distinction between the different varieties of Cannabis sativa – industrial hemp and marijuana – and considered them both a Schedule 1 controlled substance. After the passing of the 2014 Farm Bill, 41 states passed legislation related to industrial hemp, and 39 states allowed for hemp cultivation and production programs. Numerous states considered legislation related to industrial hemp in 2018, including clarifying existing laws and establishing new licensing requirements and programs. Requirements for registration, licenses and permits can include such actions as criminal background checks; periodic renewals; and reporting sales or distributions, including to whom it was sold or distributed, as well as processors.12 In 2015, the Minnesota Industrial Hemp Development Act (IHDA), outlined in Minnesota Statues 18K.01 to 18K.09, became law, creating an initiative to study the growth, cultivation and marketing of the crop. This law directed the Commissioner of Agriculture to make program rules, determine a fee structure, and perform testing and other regulatory activities.30 This allowed the Minnesota Department of Agriculture (MDA) to create an industrial hemp research pilot program to study the growth, cultivation and marketing of industrial hemp.12 All first-time applicants to the program were asked to submit an application, fingerprints and an informed consent form, a federal/state criminal background check, payment and a detailed map of the field(s) to be cultivated. Pilot participants were – and still are – required to provide reports regarding seed varieties planted, agronomic findings and any processing, distribution and sales of products.31 2017 Industrial Hemp Pilot Program Locations • 1 - 5 • 5 - 10 • >10 Source: “Industrial Hemp Pilot Program Annual Report,” Minnesota Department of Agriculture29 Building an Industrial Hemp Industry in Minnesota Building an Industrial Hemp Industry in Minnesota 20 Participation and support for the program has grown. In 2016, there were six pilot program participants in Minnesota who harvested approximately 40 acres of hemp for the first time since the 1950s. In 2017, MDA received 47 applications for its pilot program; 40 became certificate holders. Of those, 33 were licensed hemp growers, and there were 56 total fields. Participants cited a range of goals, including gaining economic viability from an alternative crop to corn and soybeans; testing varieties for seed, grain, fiber and CBD production; expanding crop rotation; exploring food, fiber, and/or CBD markets; and researching and testing hemp processing methods to create products such as food, hemp seed oil, essential oils, fiber products and CBD extracts.30 MDA also issued pilot program certificates to two testing laboratories, a hemp seed dealer, a researcher and three processors. Of the 1,210 acres planted in 2017, 1,100 acres were harvested, primarily for hemp seed or grain. Four pilot participants harvested the hemp fiber, or the fiber in addition to the grain. The average plant height at maturity was 52 inches, with an average grain yield of 790 pounds per acre.30 Costs for hemp production were reported between $170 and $1,000+ per acre, not including land rent. The cost for seed was about $120 per acre. There were no profits reported within the 2017 pilot program report.30 The remaining unharvested acreage suffered from extremely heavy rains after planting, improper planting methods and excessive weed pressure.29 Applications for the 2019 Pilot Program began in October and surpassed 2018 participation. But, as one grower commented, “The most difficult predicament facing every Minnesota hemp grower is cleaning and processing the seed,” due to the lack of places to sell the hemp grain or fiber. There are growers that see opportunity on the value-added side, but acknowledge it will take time and additional funding to get an industry established.30 The foundation for dramatic changes began with the passage of the new farm bill in December 2018. As Rick Weissman, founder and president of High Falls Extracts in New York,

predicted in Money Morning, passage was a game changer. “There are two primary trends in the hemisphere that are going to continue to gather more steam in 2019. The first is the health and wellness movement, which will be spurred by the proliferation and adoption of hemp-based CBD products, which are starting to go mainstream. Hemp-based CBD products will continue to supplant synthetically derived pharmaceuticals. The second trend will be the revitalization of the agriculture/farming communities in states that have allowed their farmers to grow hemp.”32 That could jumpstart the Minnesota hemp industry. “ SOYBEANS, MANY YEARS AGO, [WERE] NEVER HEARD OF, AND NOW IT’S A HUGE CROP FOR MINNESOTA AND THE ENTIRE WORLD. WE LOVE CANADIANS, BUT WE WANT TO BE MAKING THAT STUFF HERE. WE KNOW WE CAN GROW IT IN MINNESOTA. ” - Andrea Vaubel, Assistant Commissioner, Minnesota Department of Agriculture, StarTribune, 2018 Building an Industrial Hemp Industry in Minnesota 21 As Harold Stanislawski, project development director at AURI, stated just prior to passage, “If the farm bill passes, it will get industrial hemp on the playing field for commercial production. It opens the door for crop insurance, it opens the door for federal crop research grants and it really opens the door for banking. When that happens, things get a lot easier to move forward. Right now, it’s really entrepreneurship at its best and risk-taking at its best.”33 A CHANGING LANDSCAPE With the 2018 Farm Bill signed, MDA experienced a surge in hemp interest. “We’ve been inundated with calls from people wondering what it (bill passage) means, and if they need to get a license anymore. The short answer is yes, they still need a license – and not much is changing in Minnesota, at least in 2019,” explained Margaret Wiatrowski, industrial hemp program coordinator with MDA, referring to the fact that this will allow for uninterrupted production and processing of industrial hemp in Minnesota while the USDA develops its processes.34 MDA is required to prepare a state plan for USDA approval on how it will regulate hemp and license growers. In the meantime, the hemp pilot program will continue until commercial hemp licensing begins. MDA is still required to license growers and test the fields to ensure THC compliance. Hemp will be removed from the Controlled Substances Act (CSA) and be recognized as an agricultural crop by the federal government. In addition, the farm bill allows interstate movement of hemp seed, plants and processed hemp products, and creates a path for farmers to be eligible for crop insurance and grants through USDA.35 The Food and Drug Administration (FDA) will continue to regulate ingestible and topical hemp products, including CBD, and will not automatically allow hemp-derived CBD to be sold in any and all forms. It should be noted that the MDA Industrial Hemp Program does not have authority to make any determinations for the legality of food, beverage, cosmetic or animal feed products. As the StarTribune editorial board noted, “Hundreds of millions of dollars of goods made with hemp — everything from hand lotion to teas and supplements — are sold in the United States, but rely on imported hemp and hemp byproducts. That’s been a boon for Canada, where hemp is already legal. Hemp could have strong potential in Minnesota . . . Already there are estimates that the U.S. cannabis industry could go from $800 million now to $20 billion within four years.”36 HEMP FOR HUMAN CONSUMPTION Hemp food products can be made from seed or grain in Minnesota. The FDA considers THC (tetrahydrocannabinol) and CBD (cannabidiol) to be regulated drugs, however; meaning they cannot be found in any traceable amount in food. Also, there are requirements regarding retail and wholesale food-handling licensure. If hemp is to be utilized within a product intended for human consumption, it’s important to contact MDA’s Food and Feed Safety Division to fully understand the legalities of hemp food products. This hasn’t stopped some Minnesota entrepreneurs from trying to offer hemp-infused food products. Cosmic Beans Dispensary in Minneapolis announced in October 2018 that it would begin selling coffee and tea “energy drinks” made with CBD oil, a popular nutritional supplement derived from hemp. The owner’s plans received legal pushback, according to Minnesota Daily. Doing so would be a “critical violation” of the Minneapolis Health Department food codes, Daniel Huff, environmental health director with the health department, was quoted as saying at the time. Until CBD oil is FDA-approved, or generally recognized as safe (GRAS), business owners cannot add it to food or drinks.37 Building an Industrial Hemp Industry in Minnesota Building an Industrial Hemp Industry in Minnesota 22 CBD represents a complicated issue from a legal standpoint. The regulations set by various departments, like the Minneapolis Health Department, can differ from those set by the FDA. As the hemp industry is still in its infancy, the laws and regulatory agencies haven’t necessarily kept pace.37 CBD oil can be found on the shelves of natural food stores and head shops — stores that

sell Cannabis paraphernalia — across the Twin Cities. Although it hasn't been approved for medical use, many claims have been made about CBD products that have not been through clinical trials, but that are still often purchased to treat everything from anxiety to restless leg syndrome. As demand grows for the oil, farmers and entrepreneurs in Minnesota want a piece of the market. But, according to a report in October 2018 on Minnesota Public Radio (MPR), the murky legal status of the CBD supplement is a challenge for an industry that already brings in an estimated $700 million a year nationally.38 Cody Wiberg, executive director of the Minnesota Board of Pharmacy, was quoted as saying that state authorities have been aware of CBD oil for months. He believes that the 2014 federal law to allow hemp farm pilot projects does not provide for the sale of CBD oil. Wiberg said federal agencies "have issued this statement basically saying that they believe Congress intended this for research in pilot projects, but not for mass commercialization. The FDA has further specifically stated that CBD cannot be sold as a dietary supplement."38 Board of Pharmacy officials are reportedly not planning enforcement actions against manufacturers or stores that sell CBD oil.38 According to an article in The Land, certified organic hemp grain is preferred over conventional in the food market. Achieving food-grade purity is difficult for Minnesota hemp farmers, hence growers have been somewhat frustrated with difficulty selling their grain.22 Due to the ever- changing nature of the hemp industry, MDA advises growers to secure a contract before they plant. Also, thus far, hemp is not an approved ingredient for pet food. Including phytocannabinoids in animal feed, such as livestock, swine and equine diets, will be a potential market; however, these products will have to achieve AAFCO (American Association of Feed Control Officials) certification before being marketed.30 [For more information, contact the MDA's Pet Food Program within the Commercial Feed Program.] Building an Industrial Hemp Industry in Minnesota 23 IS THERE MONEY IN HEMP? Prices for hemp grain fluctuate in the United States – and particularly in Minnesota — due in part to the infancy of the industry. In 2015, the average hemp grain price in Alberta was $0.54 USD per pound.39 Typical returns for hemp grain in the United States have been between $0.40 and $0.70 per pound for conventional, and $0.75 to 1.00 per pound for organic.40 MDA pilot program growers reported a contract price of $0.50 a pound for conventional and $1.08 to $1.18 per pound for certified organic in 2017. Across the 1,100 acres harvested, the average yield of cleaned grain was 790 pounds per acre, but some growers reported 2,000 pounds on the high end.29 In Minnesota, hemp seed prices vary based upon the variety and whether it is domestic or imported. In 2016, hemp producers in Minnesota reported costs per acre between $970 and $2,500 per acre, according to MDA. In 2017, reports indicated production costs of between $300 and $600 per acre, not including land investment.31 While demand for hemp is growing, the need for processing facilities remains a challenge. "We lack a significant amount of processing in the state; that limits the participation of farmers," observed Anthony Cortilet, MDA.41 "I think the processing is coming. We see some people that are in the program that are spending money, and there are people from all over the country and other countries that have inquired about coming to Minnesota to build a big processing facility. My guess is, with that kind of buzz, this is only going to grow."41 FROM FIELD TO SALES As within any new industry, entrants often need basic information, such as when do you plant hemp in Minnesota? With Minnesota's growing conditions, planting too early can cause seedling mortality, therefore, ideal seeding dates for hemp production in the state are between mid-May and mid-June. Soil temperatures should be at least 45 to 50 degrees Fahrenheit.40 Where can you buy hemp seed? Only hemp license holders are legally allowed to possess industrial hemp seeds in the state of Minnesota. MDA pilot program participants can obtain industrial hemp seed from in-state, domestic or international sources.40 How do you sow it? Most conventional drills and seeders will work for hemp, but experts advise using lower air volumes to avoid seed cracking. Seed should be planted shallowly (0.5"- 1" maximum) into a firm seedbed, and one should avoid soil compaction as well as not seed before a large rain event.40 Hemp grain is generally harvested by straight combining, however, swathing is also used. Industrial hemp seed is harvested when approximately 75 percent of the seeds are ripe; it starts to shatter about 90 to 120 days after planting, depending upon the variety and local climatic conditions. High winds and bird predation can be major problems. Harvest is recommended at 18 to 20 percent moisture, with immediate drying to reach eight to 10 percent moisture for storage.40 Building an Industrial Hemp Industry in Minnesota Building an Industrial Hemp Industry in Minnesota 24 " THE MOST DIFFICULT PREDICAMENT FACING EVERY MINNESOTA

HEMP GROWER IS CLEANING AND PROCESSING THE SEED. ” - Minnesota Industrial Hemp 2017 Pilot Program Participant As Anthony Cortilet from MDA pointed out, “It’s a different form of agriculture. You have to think and engineer things a little differently. But, just fly over Canada. They have giant farms that are harvesting and producing hemp, whether its fiber, CBD or you name it. It’s new, so American farmers have to get up to speed. There is a learning curve to growing anything new.”41 Harold Stanislawski agrees. “One of the things we’ve looked at within AURI is the resources needed in the state. The easiest path forward is to get mobile decortication here first. Then we can better characterize and understand the type of fibers that are coming out and start providing some of those fibers to end users in Minnesota for testing and, eventually, adoption. To obtain decorticated fiber today, fiber has to either go to Nebraska or Kentucky where decortication facilities operate.”33 Another option is a collaborative approach, such as the Colorado Hemp Processing Cooperative, organized to provide seed to sale harvesting and processing services to the industrial hemp industry. With this model, Minnesota farmers could belong to the co-op or LLC and share risk as well as profits. This framework has already been established within Minnesota for other commodity industries to gain legitimacy, quality assurance and return on investment. Such a concept would allow farmers to work together rather than everybody trying to do it themselves. Growers are, of course, responsible for locating their own buyers, but can contact a hemp trade association to learn more about marketing opportunities, such as the Hemp Industries Association or the National Hemp Association. RESEARCH STILL NEEDED As the industrial hemp industry matures in Minnesota, simultaneously, there is a need to continue expanding the knowledge behind it. Questions that need further exploration include these, among others: What’s the best method of sowing? What’s the best method of weed control? What herbicides are allowed and best for use on hemp? Where does hemp fit into a crop rotation? What are the major pest issues? How can seeds be tested for reliability and THC level? What diseases are going to be issues in Minnesota? What are the best extraction methods for CBD? What’s the anticipated yield? Building an Industrial Hemp Industry in Minnesota 25 PROFILE: MINNESOTA HEMP FARMS INC. When the Minnesota Department of Agriculture approved the Industrial Hemp Pilot Program, John Strohfus was the first farmer to apply for, and be granted, a license to grow industrial hemp. That was not by accident. “I wanted to be first. I knew that being first doesn’t guarantee success, but it helps and gives you a jumpstart,” Strohfus said. “I knew it was going to be difficult, but I knew I was going to be able to figure it out. It was a good decision. And it’s been a lot of work.” Strohfus runs Minnesota Hemp Farms Inc., the largest producer of hemp products in Minnesota, located near Hastings. In 2018, Strohfus harvested his first certified organic hemp crop. The business focuses on growing the plant for food, fiber and CBD nutraceutical markets. Minnesota Hemp Farms also offers consulting, seed sales, planting and harvesting services in addition to “Field Theory,” a food brand available for sale online and in retail stores. When he started farming hemp, his knowledge of the plant, its history and its potential was limited. “I thought hemp was the stalk of the marijuana plant. I didn’t know anything. I probably wasn’t even as smart as the average consumer is now,” he said. He also admits to doing everything backwards. He planted hemp, grew it and then tried to process the crop and find a market. “We probably violated the first rule of farming which is don’t plant a crop unless you have a market for it, Instead, we did basically the opposite,” he said. Since that first harvest, Strohfus has learned a lot and he has become one of the state’s leading hemp authorities. He took his product and found customers and new uses. He sells planting seed, hulled seed, cold press oil and hemp protein. He developed new products like hemp oil, hemp seeds for salads and smoothies, and a warming muscle balm, which are available in 65 grocery stores across the Twin Cities. He is a frequent speaker on hemp issues, an informal resource for hemp growers and entrepreneurs as well as an organizing force for the larger Minnesota hemp industry. Strohfus worked for many years with the Agricultural Utilization Research Institute (AURI) and credits the organization with helping him improve both his farming and his business. The “hemp prohibition” is ending, Strohfus said, and there are a lot of players ready to dive into food, health and beauty products, fibers and for medicinal purposes. He will always grow hemp, but Strohfus says his future is in the business side. He enjoys marketing, networking and coming up with ideas. He looks for ways to put the right people together to discuss hemp and he wants to open doors to Minnesota’s agricultural economy and agribusiness industry. He travels the state speaking to scientists, farmers, educators, legislators and entrepreneurs. He wants to work with producers to

connect them to processors, packagers, labelers and eventually consumers. “The future is everything. There is explosive growth everywhere,” he said. “We have figured out this innovative product that actually gives people a lot of amazing benefits. It would be like discovering ibuprofen essentially.” Building an Industrial Hemp Industry in Minnesota Building an Industrial Hemp Industry in Minnesota 26 FOOD LANDSCAPE The versatility of hemp as a food source has long been recognized. With regulations and product awareness evolving, hemp’s use within the food industry is projected to grow. HEMP AS A FOOD PRODUCT Hemp-derived ingredients such as seeds, “hearts” (the shelled seeds of the industrial hemp plant) and oils are appearing with more frequency in global food markets, including Europe and North America.42 As CBD popularity grows in the United States, the FDA continues to have regulatory authority over its use in food and beverages. In a December 20, 2018 statement43 following the signing of the farm bill, FDA Commissioner Scott Gottlieb said three ingredients derived from hemp – hulled hemp seeds, hemp seed protein and hemp seed oil – are GRAS (Generally Recognized as Safe) foods and will not require additional approvals if marketers do not make claims that they treat disease. He did restate his agency’s stance, however, that CBD is a drug ingredient and therefore illegal to add to food or health products without approval from the FDA.44 Lack of FDA guidance over past years has not prevented successful introduction of hemp food products to the market. In 2018, U.S. hemp-based food sales totaled $150 million.4 The following graphic illustrates the expected growth of the hemp industry by category total in 2022.45 “ HEMP’S USE WITHIN THE FOOD INDUSTRY IS PROJECTED TO GROW. ” Building an Industrial Hemp Industry in Minnesota 27 Source: “The Global State of Hemp: 2019 Industry Outlook,” New Frontier Data, Hemp Business Journal45 Industrial hemp can be used both for its seeds and oil content. Hemp seeds offer a high nutritional appeal, containing between 25 to 30 percent protein, insoluble fiber, omega-3 fatty acid and traces of lesser-known beneficial fatty acids.46 Contrary to popular belief, hemp seeds do not possess the same psychoactive properties as its biological cousin, marijuana. Industrial hemp crops are required by law to be destroyed if tetrahydrocannabinol (THC) levels exceed the legal amount of 0.3 percent.42 In addition to the fiber, protein and essential fatty acids hemp seeds contain, they offer a plethora of micronutrients including thiamin, zinc, vitamin E, phosphorous, potassium, magnesium and calcium.47 Technically, the seeds are achene fruits, consisting of a single seed with a hard outer shell.48 Seeds can be consumed raw, cooked or roasted. Below is a breakdown of the nutritional content by percentage found within the hemp seed. TYPICAL NUTRITIONAL CONTENT (%) OF HEMP SEED Source: NSW Parliamentary Research Service, March 201647 $2.6 BILLION U.S. HEMP-BASED PRODUCT SALES BY CATEGORY IN 2022 (estimated) $1,500 $1,200 $900 $600 $300 $0 Hemp- Derived CBD Industrial Applications Personal Care Food Consumer Textiles Supplements Other Consumer Products M IL LI O N S $1,299 $588 $259 $212 $183 $54 $29 WHOLE SEED SEED MEAL Oil 35.5 11.1 Protein 24.8 33.5 Carbohydrates 27.6 42.6 Moisture 6.5 5.6 Ash 5.6 7.2 Energy (kJ/100 g) 2200 1700 Total dietary fibre 27.6 42.6 Digestable fibre 5.4 16.4 Non-digestable fibre 22.2 26.2 Building an Industrial Hemp Industry in Minnesota Building an Industrial Hemp Industry in Minnesota 28 Hemp seeds must go through additional processing to be converted into hemp seed oil, which can be used in a variety of food and non-food products. First, the seed must be thoroughly cleaned to prevent contamination from other crops, as well as removing any possible leaf matter. The cleaned seeds are then loaded into hoppers that extract oil by pressing the seeds into a “hemp cake” and separating out the oil. While chemical extraction of hemp seed oil is also a possible method, cold pressing is currently the most common process for producing hemp seed oil. As the oil cools from the extraction process, it is filtered into a holding reservoir to begin the next phase, a cold-filter filtration process. This filter removes any remaining solids from t