Bioeconomy Development Opportunity Zone Risk Rating

'A'

The Region Nine/St James, MN, BDO Zone is rated 'A', due to significant amounts of underutilized corn stover available for a new bio-based project, with virtually no competition for this feedstock.

Rating Parameters:

Category	Rated Quantity	Delivered Price	BDO Zone Size
Corn Stover	1,400,000 BDT/yr	$95-$108 (BDT)	75-mi drive distance from St. James, MN

BDO Zone Assets

- **Over 1,400,000 bone dry tons of underutilized corn stover at low risk.**
- **One of the highest yielding corn producing areas in the country.**
- **No established competition for corn stover in the region.**
- **Redundancy of potential suppliers given the number of corn producers.**
- **Sound road infrastructure in proximity with major metropolitan areas and utilities available on site.**

BDO Zone Liabilities

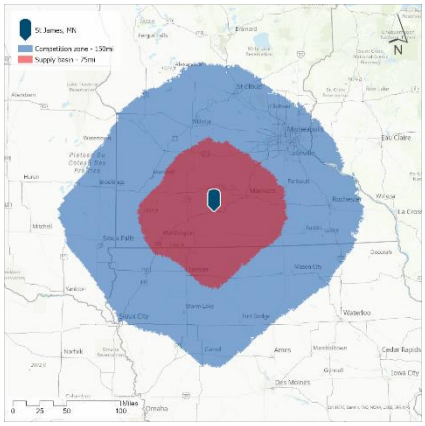
- **Producers have limited experience in harvesting and collecting corn stover efficiently in terms of cost and time.**
- **There is no established supply chain infrastructure to support a commercial scale operation.**
- **The corn stover harvesting season is shorter due to weather, compared to other major corn-producing regions in the country**
- **Challenges with attraction and retention of skilled labor needed for field operations and logistics, both from a lack of experience in this activity and increasing cost of living.**

BDO Zone Risk Rating

The Region Nine, MN, Bioeconomy Development Opportunity Zone is rated 'A,' or 'low' risk.

Risk Rating Grades are defined as follows: AAA (*extremely low*), AA (*very low*), A (*low*), and BBB (*low-moderate*), BB (*moderate*), B (*moderate-high*), C (*high*).

St. James, MN BDO Zone



Scoring & Rating Methodology

In assessing the biomass supply chain risk for the Bioeconomy Development Opportunity (BDO) Zone, 72 Risk Indicators from the US Standards for Biomass Supply Chain Risk (BSCR) were applied. These BDO Zone Risk Indicators are the subset of BSCR Risk Indicators applicable to evaluating feedstock risk within a BDO Zone.

Feedstock quantities are expressed in bone dry tons per year (bdt/yr). While feedstock costs are expressed in United States (USD) dollars. Maximum transport distance is based on a 75-mile driving distance from the center point (St. James, MN).

The BDO Zone rating is based on an aggregation of the scores assigned to each BDO Zone Risk Indicator (RI) assessed in this report. First, each BDO Zone Risk Indicator is given a **Raw Risk Likelihood (RRL)** score which denotes the likelihood of a risk to future BDO Zone projects due to the Risk Indicator. RRL Scores are scaled as either *very low* (2), *low* (4), *medium* (6), *high* (8) or *very high* (10).

Next, each BDO Zone Risk Indicator is given a **Raw Risk Impact (RRI)** score which denotes the impact on a future BDO Zone project due to the Risk Indicator. RRI scores are scaled as either *very low* (2), *low* (4), *medium* (6), *high* (8) or *very high* (10). Impact level scores are

based on the impact level of a risk on the successful development and deployment of a BDO Zone project with no mitigation measures.

Then, the **Gross Risk Indicator (GRI)** score is calculated as the product of the RRL and the RRI scores. For example, if the 'Competitor Price and Price Sensitivity' is scored at a RRL of 2 and a RRI of 6, then the GRI for this risk indicator is $2 \times 6 = 12$.

If the analyst deems that a typical bio-based project could put in place economically reasonable measures or best practices that mitigate either the likelihood (RRL) or the impact (RRI), or both, then the GRI will be notched accordingly.

Finally, the **Loaded RI** score for each Risk Indicator is calculated as the product of the Total Notch and the GRI score, which is the final score for that indicator.

Loaded RI scores of 20 or less are deemed *very low risk*; scores between 21 and 40 are deemed *low risk*; scores between 41 and 60 are deemed *medium risk*; scores between 61 and 80 are deemed *high risk*; and scores of 81 and greater are deemed *very high risk*.

The total risk rating for the BDO Zone is the average of all Loaded RI scores. The BDO Zone score for St James, MN is ***21.40 out of 100, resulting in an 'A' designation***.

All scoring and rationale for each Risk Indicator are provided in Appendix B.

Analyst Notes

The Region Nine BDO Zone assesses competition in a 150-mile drive distance from St. James, MN, and the potential feedstock supply within 75-mile drive distance from the same location, comprising 33 counties in total, 26 being in Minnesota and 7 in Iowa.

This supply zone is one of the most productive corn growing regions in the country, with a 10-year average productivity of 187 bu/acre and production of around 550M bushels/year, consistently yielding high quantities of biomass.

Historically, there has never been large scale demand for corn stover, resulting in little demand, no pricing references and consequently virtually no competition for feedstock in the region, apart from one digestor operating at the edges of the supply zone in Le Sueur, MN, about 70 NE from St James.

In order for this region to reliably supply a bio-based project, it would require the development of the logistics assets necessary to harvest, collect, transport and store feedstock at a commercial scale. The reputation of the developer would play a significant role in convincing farmers to participate in this endeavor, since corn stover is a secondary feedstock and the acquisition of field equipment would be a considerable financial investment.

The infrastructure in Southern Minnesota is considered one of the best in the country with several major food processing facilities operating in the State, which results in a robust intermodal network with several access options to national and international markets.

BDO Zone Assets

There are over 1,400,000 bdt/year of corn stover available within the supply zone at low risk after the consideration of factors such as sustainable removal rates and 35% farm participation rate, with virtually no competition for this feedstock. Due to the high corn yields and the great number of farmers annually producing large quantities of corn, we expect that there would be a robust redundancy in the availability of biomass with little annual variation in total production.[1]

In regard to the infrastructure assessed in New Ulm, MN, the industrial park is well situated with access to major highway networks to markets and export options. All utilities are available for the parcels at the industrial park, which is zoned for heavy industry.

BDO Zone Liabilities

The main liabilities of this BDO Zone are the risk categories related to experience and the availability of equipment for harvesting and transporting corn stover. There is

[1] Refer to Table C-2 In Appendix C

no history of commercial scale demand for this feedstock in the supply zone, therefore, the majority of corn producers do not own proper field equipment for harvesting and collecting this feedstock in a timely and cost-efficient manners, and consequently lack experience in this operation.

There are few crop growers that do limited amounts of bailing for use in animal bedding, and commonly trade with neighbors, thus there is no pricing reference for this product, either as biomass or as bales.

In addition, the stover harvest window in Region Nine is one of the shortest in the country due to the weather pattern, between 25 and 30 days only, creating an increased risk for quantity and quality.

The BDO Zone is expected to face challenges regarding the attraction and retention of skilled labor is required to run biomass field and logistics operations, both due to the lack of experience in these types of operations, and because of the general price increase in the cost of living. Record high mortgage rates are a hurdle for families considering moving to a new area for a new job that requires selling and buying a new home.

Infrastructure Profile

Regarding the necessary infrastructure to accommodate and support the installation and long-term operation of a commercial biomass project, this study evaluated 25 tangible risk factors, such as physical infrastructure, logistics, social influences, and workforce statistics in the city of New Ulm, MN (30 miles North of St James, MN).

The industrial park assessed in this report can be considered a greenfield, with all main utilities running adjacent to the parcels and requiring minor extensions into a new facility.

We did not find any major issues found in the city permitting process for new projects, and several industries already operate in that location. The site is 40 miles to Interstate 90, a major East-West artery and 70 miles to Interstate 30, a North-South corridor; however, there is no immediate access to rail transportation. The proximity to Minneapolis/St. Paul means close access to a large metropolitan market. Housing and cost of living remain the biggest hurdle for attracting labor to the region, as high mortgage rates are discouraging families from moving.

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Figure 1: Risk Indicators (Sorted by Risk Level)

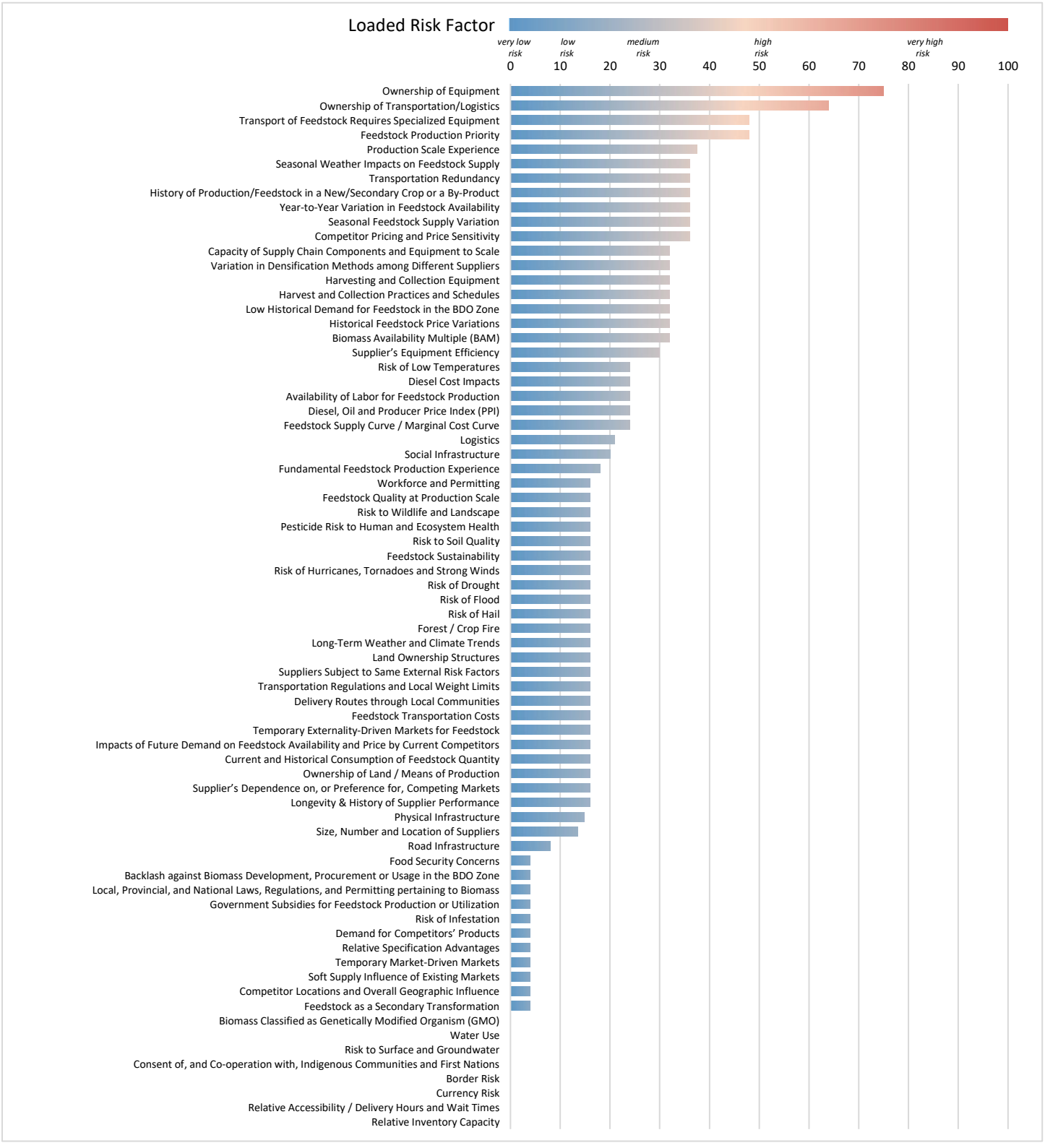


Table 1: Risk Indicators and Associated Scores

	Feedstock Supply Chain Risk Indicators	Raw Risk Likelihood	Raw Risk Impact	Gross Risk Indicator	Mitigation /Notching	Loaded RI Score
	Category 1.0: Supplier Risk					
1.1.1	Longevity & History of Supplier Performance	4	4	16	NN	16
1.2.1	Supplier's Dependence on, or Preference for, Competing Markets	4	4	16	NN	16
1.3.1	Ownership of Land / Means of Production	4	4	16	NN	16
1.3.2	Ownership of Equipment	10	10	100	25%	75
1.3.3	Ownership of Transportation/Logistics	8	8	64	NN	64
1.3.4	Feedstock as a Secondary Transformation	2	2	4	NN	4
1.4.1	Fundamental Feedstock Production Experience	8	6	48	63%	18
1.4.2	Production Scale Experience	10	10	100	63%	37.5
1.5.1	Supplier's Equipment Efficiency	10	8	80	63%	30
1.6.1	Feedstock Production Priority	8	8	64	25%	48
	Category 2.0: Competitor Risk					
2.1.1	Competitor Locations and Overall Geographic Influence	2	2	4	NN	4
2.1.2	Current and Historical Consumption of Feedstock Quantity	4	4	16	NN	16
2.1.3	Competitor Pricing and Price Sensitivity	6	6	36	NN	36
2.1.4	Impacts of Future Demand on Feedstock Availability and Price by Current Competitors	4	4	16	NN	16
2.1.5	Soft Supply Influence of Existing Markets	2	2	4	NN	4
2.1.6	Temporary Market-Driven Markets	2	2	4	NN	4
2.2.1	Relative Inventory Capacity	NR	NR	NR	NR	NR
2.2.2	Relative Accessibility / Delivery Hours and Wait Times	NR	NR	NR	NR	NR
2.2.3	Relative Specification Advantages	2	2	4	NN	4
2.2.4	Demand for Competitors' Products	2	2	4	NN	4
	Category 3.0: Supply Chain Risk					
3.1.1	Biomass Availability Multiple (BAM)	4	8	32	NN	32
3.1.2	Feedstock Supply Curve / Marginal Cost Curve	6	4	24	NN	24
3.1.3	Seasonal Feedstock Supply Variation	8	6	48	25%	36
3.1.4	Year-to-Year Variation in Feedstock Availability	6	6	36	NN	36
3.2.1	Historical Feedstock Price Variations	8	8	64	50%	32
3.2.2	Low Historical Demand for Feedstock in the BDO Zone	8	8	64	50%	32
3.2.3	History of Production/Feedstock in a New/Secondary Crop or a By-Product	6	6	36	NN	36
3.3.1	Diesel, Oil and Producer Price Index (PPI)	6	4	24	NN	24
3.3.2	Currency Risk	NR	NR	NR	NR	NR
3.3.3	Border Risk	NR	NR	NR	NR	NR
3.3.4	Temporary Externality-Driven Markets for Feedstock	4	4	16	NN	16
3.4.1	Harvest and Collection Practices and Schedules	8	8	64	50%	32
3.4.2	Harvesting and Collection Equipment	8	8	64	50%	32
3.4.3	Variation in Densification Methods among Different Suppliers	8	8	64	50%	32
3.4.4	Availability of Labor for Feedstock Production	8	8	64	63%	24
3.5.1	Feedstock Transportation Costs	4	4	16	NN	16
3.5.2	Diesel Cost Impacts	4	6	24	NN	24
3.5.3	Transport of Feedstock Requires Specialized Equipment	8	6	48	NN	48
3.5.4	Delivery Routes through Local Communities	4	4	16	NN	16
3.5.5	Transportation Regulations and Local Weight Limits	4	4	16	NN	16
3.5.6	Road Infrastructure	4	2	8	NN	8
3.5.7	Transportation Redundancy	8	8	64	44%	36
3.6.1	Size, Number and Location of Suppliers	6	6	36	63%	13.5
3.6.2	Suppliers Subject to Same External Risk Factors	4	4	16	NN	16
3.6.3	Land Ownership Structures	4	4	16	NN	16
3.7.1	Seasonal Weather Impacts on Feedstock Supply	6	6	36	NN	36
3.7.2	Long-Term Weather and Climate Trends	4	4	16	NN	16
3.7.3	Forest / Crop Fire	4	4	16	NN	16
3.7.4	Risk of Infestation	2	2	4	NN	4
3.7.5	Risk of Hail	4	4	16	NN	16
3.7.6	Risk of Flood	4	4	16	NN	16
3.7.7	Risk of Drought	4	4	16	NN	16
3.7.8	Risk of Hurricanes, Tornadoes and Strong Winds	4	4	16	NN	16
3.7.9	Risk of Low Temperatures	4	6	24	NN	24
3.8.1	Government Subsidies for Feedstock Production or Utilization	2	2	4	NN	4
3.8.2	Local, Provincial, and National Laws, Regulations, and Permitting pertaining to Biomass	2	2	4	NN	4
3.8.3	Backlash against Biomass Development, Procurement or Usage in the BDO Zone	2	2	4	NN	4
3.8.4	Consent of, and Co-operation with, Indigenous Communities and First Nations	NR	NR	NR	NR	NR

3.8.5	Food Security Concerns	2	2	4	NN	4
3.9.1	Feedstock Sustainability	4	4	16	NN	16
3.9.2	Risk to Soil Quality	4	4	16	NN	16
3.9.3	Risk to Surface and Groundwater	0	0	0	NN	0
3.9.4	Water Use	0	0	0	NN	0
3.9.5	Pesticide Risk to Human and Ecosystem Health	4	4	16	NN	16
3.9.6	Risk to Wildlife and Landscape	4	4	16	NN	16
3.9.7	Biomass Classified as Genetically Modified Organism (GMO)	NR	NR	NR	NR	NR
	Category 4.0: Feedstock Scale-up Risk					
4.1.1	Feedstock Quality at Production Scale	8	8	64	75%	16
4.1.2	Capacity of Supply Chain Components and Equipment to Scale	8	8	64	50%	32
	Category 5.0: Infrastructure					
5.1	Physical Infrastructure	3.8	3.8	14.8	NN	14.8
5.2	Logistics	4.5	4.5	21	NN	21
5.3	Social Infrastructure	4.29	4	20	NN	20
5.4	Workforce and Permitting	4	4	16	NN	16
					Average	**21.40**



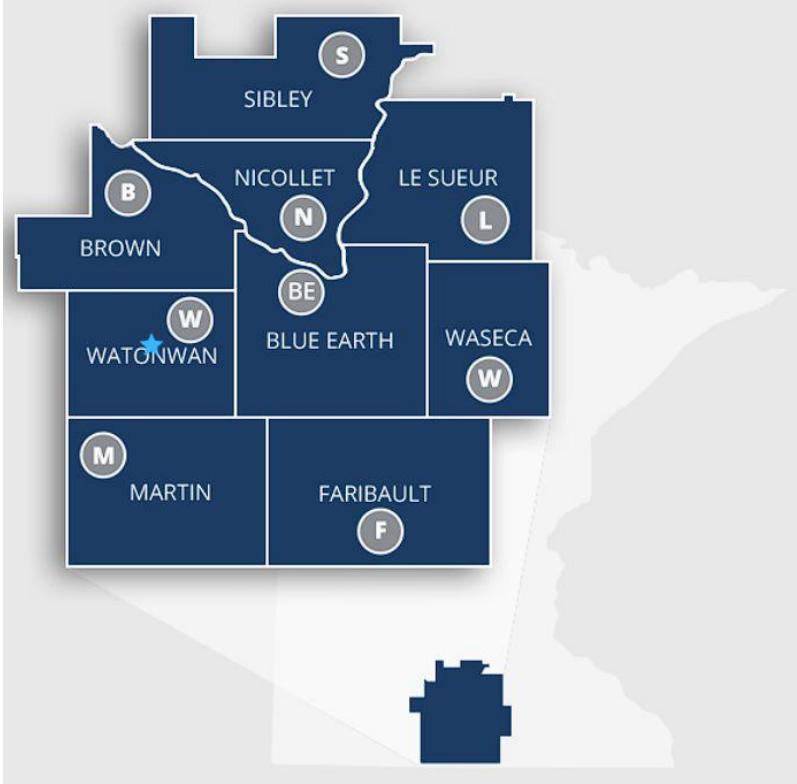
Region Nine/St James, MN, 'A' BDO Zone Independent Review Committee (IRC)

Sabine Engel – UMN – Climate Smart
Michael Johnson – County Administrator, Waseca
Tina Wilson – EDA, Waseca
Chris Dalton – City Administrator, New Ulm
Scott Schlueter – City Council, Le Sueur
Gregg Mast – Executive Director, CEEM
Jim Branstad – County Commissioner, Watonwan County
Andrea Boettger – New Ulm Administration
Paul Harris – Saint James Commission
Mike Laven – Mankato Commissioner and Region and Board Chair
Gary Richter – Mayor of Comfrey and RNDC Commissioner
Lisa Hughes – Regional Business Development Management, MN DEED
Virginia Mooty-Rutter – Energy Consultant

APPENDIX A: BIOMASS AVAILABILITY AND PRICING

This section assesses the availability and pricing of corn stover as feedstock for bioenergy, biofuels, and other potential bio-based products in the Region Nine, Minnesota (MN), BDO Zone region. The Region Nine represents 72 cities in nine counties as shown in Figure A-1. The center point for corn stover availability assessment is St. James, MN, starred in Figure A-1.

Figure A-1. Region Nine Area Map



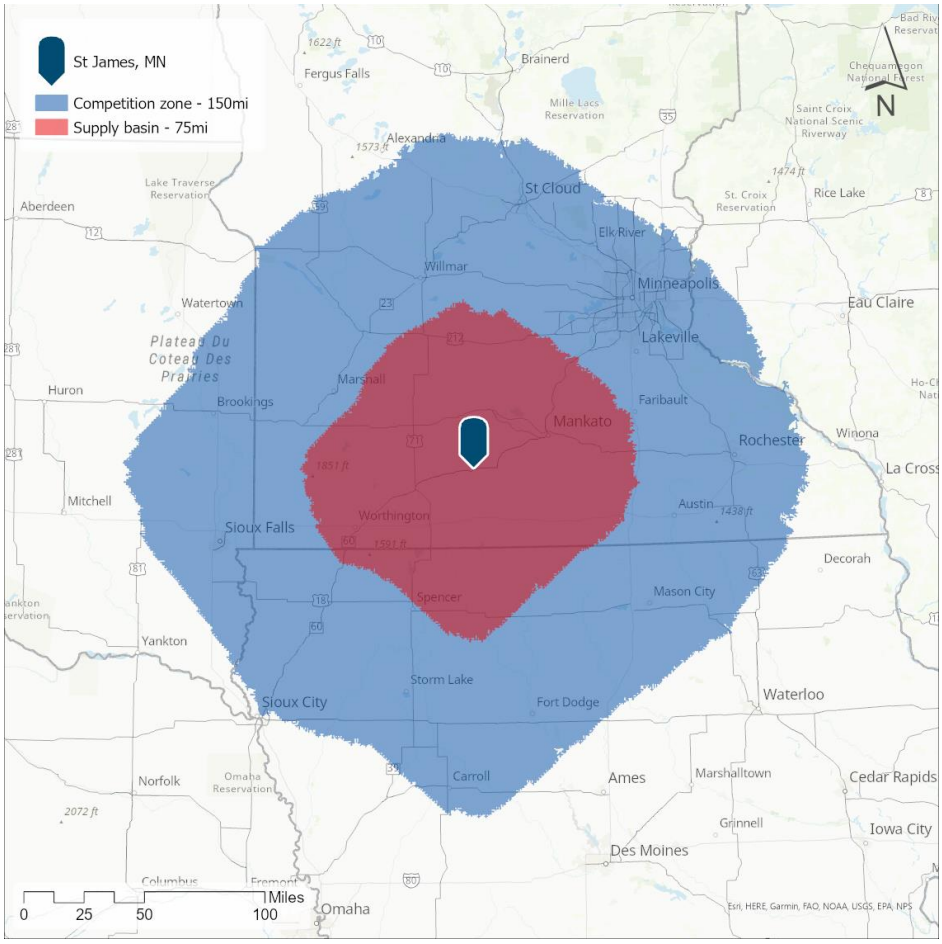
STUDY REGION

The BDO Zone Region is defined by a 75-mile drive distance from St James, MN (Figure A-2), and encompasses corn stover availability within a 75-mile drive distance from the same location (referred as the supply zone), while also investigating current and emerging competing markets within the broader 150-mile drive distance (referred as the competition zone).

The BDO Zone region's primary agricultural activities are corn and soybean cultivation, typically in rotation, and poultry and hog production in a small scale. According to the latest USDA Census data,[2] there are 16,908 farms in the BDO zone, with an average size of 264 acres. For the 2022 season,[3] corn grain was harvested in 3,178,360 acres, while soybeans were harvested in 2,601,395 acres. The 10-year average harvested area for corn is estimated to be 3,026,189 acres, and for soybeans 2,602,187 acres. Hog and pig production is around 6,017,237 animals and poultry (including turkey) are around 2,998,844.

[2] https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/
[3] https://quickstats.nass.usda.gov/

Figure A-2. Corn Stover Supply and Competition Zones



Methodology for Corn Stover Production and Availability Assessment

We used the latest USDA data[4] to assess the total production of corn grain and apply constraints from the Iowa State University's Extension and Outreach modelling[5] to calculate the theoretical availability of corn stover for removal (sustainable removal) using corn stover to grain ratio as well as the sustainability factors. When left in the field, crop residues perform several vital functions, such as maintaining soil moisture, accommodating beneficial microbes, increasing soil organic matter, and recycling plant nutrients. Therefore, agricultural land requires certain crop residues to maintain soil quality. On the other hand, excessive residues, which could occur with improved crop yields, would lead to slower soil warming in the planting season, difficulties in operating planting machinery, and increased emissions of greenhouse gases from the decay of residues. The optimum removal of crop residues is site-specific, depending on crop rotation and the soil management practices of individual farmers. As shown in Table A-1, we assumed 60% of produced corn stover is left in the field and only 40% is harvested.

[4] https://quickstats.nass.usda.gov/
[5] https://www.extension.iastate.edu/agdm/crops/html/a1-70.html

Additionally, we calculated low-risk availability of corn stover in the BDO Zone through outreach to growers and harvest and logistics companies, where we estimate the Biomass Availability Multiple (BAM),[6] and the farm participation rate. In reality, not all the produced corn stover will be available for biomass projects. Since large-scale markets for corn stover do not presently exist, farmers are likely to underestimate potential challenges (such as twine left in the fields) and the effort it takes to collect and bale corn stover at an acceptable quality (low soil contamination). Faced with the realities of actual corn stover supply and pricing and concerns over the long-term impact of corn stover removal on the soil health, some growers may decline to participate. It is noted that for economical and soil health reasons, corn stover removal is not feasible for grain yields lower than 150 bushels/acre. In the BDO Zone region, the 10-year average grain yield is 187 bushels/acre, which is 25% more than the minimum threshold of 150 bushels/acre.

In summary, for reasons such as unwillingness of some farmers to participate in the project as a supplier, uncertainties in weather conditions during the harvest season and lack of labor/equipment availability to harvest and collect corn stover, among others detailed in the risk section, BAM and farmer participation rates aim to bring a more realistic project availability estimate and respect minimum requirements for soil health.

The constraints applied to calculate the theoretical amounts of corn stover available to be removed sustainably in the supply zone can be found in Table A-1 below:

Table A-1. Assumptions to estimate the theoretical quantity of corn stover available for sustainable removal in the supply zone

Harvested corn stover to grain ratio	1:1	Total corn stover produced given the production of corn grain
Sustainable Removal Rate	40%	Biomass sustainably harvested from field
Equipment Efficiency	82%	Efficiency of field equipment to harvest and collect corn stover from the field
Moisture Content[7]	22%	Average moisture content of corn stover at the harvest time

The bale weight (wet basis) range is assumed to be 1,100 and 1,300lbs for large 5' x 6' round bales and 4' x 4' x 8' square bales, respectively. In this project, we use the average bale weight of 1,200 lb. [8]

Pricing calculations to estimate the cost of a bale at the roadside follow the Iowa State University's Extension and outreach modelling[9] and take into account the nutrient deficiency from removing the biomass from the field. In this project, we applied the latest fertilizer prices[10] as follows:

[6] Biomass Availability Multiple (BAM) indicates the degree of redundancy in the biomass supply in the BDO Zone. BAM is the mean ratio of biomass feedstock available to a project, in relation to delivered cost, divided by the biomass project's mean rated quantity. BAM is a strong indicator of supply chain resilience when stressed by supply shortage and/or supplier breach.
[7] Industrial Corn Stover Harvest, Iowa State University Extension and Outreach, PM 3050 page 6, March 2024
[8] Bale weight varies based on equipment. Each manufacturer will publish numbers. For example, AGCO high density balers will compact to 13 lbs/cubic feet. Publications refer to "assumptions".
[9] Estimating a Value for Corn Stover | Ag Decision Maker (iastate.edu)
[10] https://www.dtnpf.com/agriculture/web/ag/crops/article/2023/08/30/major-retail-fertilizer-prices-lower

Table A-2. Nutrition calculation assumptions

Nutrient Removal Rate (lbs./ BDT of biomass)		DTN Fertilizer Price (Aug, 30th, 2023)		Cost of Nutrient Removal ($/ BDT)
N	0	DAP	735	
P2O5	3.5	P/ lbs.	0.75	1.14
P	1.5	Potash	355	
K2O	19.2	K/ lbs.	0.91	14.44
K	15.9			

The calculated dollar value associated to the nutrient deficit from the biomass removal in this study is $15.58/BDT, referred as the "material cost". The material cost is the price paid to the crop growers to have access to their corn stover at the field.

Other assumptions considered in the methodology include:

1) Given fair corn stover prices, growers will likely be willing to supply;
2) The biomass project developer will successfully invest in creating the relationships with growers to establish supply;
3) Once the biomass facility is commissioned and the price of the corn stover becomes attractive, and the supply chain develops, participation levels will likely increase.

Historical Corn and Corn Stover Production

As mentioned above, we utilized USDA's National Agricultural Statistics Service[11] data, which provides 10-year grain yields, production and area harvested at the county level, with the latest data being 2022. Based on USDA harvest data, the average yield of corn grain is estimated to be around 187 bushels /acre. As shown in Table A-1, the best practice for sustainable corn stover harvesting suggests[12] 40% removal of total produced crop residues. We assume corn stover to be at 22% moisture. Therefore, with the given yields for the supply basin, average removal yield of corn stover is estimated to be 1.34 BDT/ acre.

Figure A-2 shows the total planted and harvested corn in the supply zone. On average, 96% of the planted acreage has been harvested in the supply zone for the past 10 years. The 10-year average corn harvested area in the supply zone is 3,026,189 acres. Data for the 2022 harvest season shows 3,178,360 acres of corn were harvested, which is about 5% above the ten-year average. We used a 10-year average to account for acreage fluctuation dedicated to a crop from year to year, depending on market signals, and yields that vary according to weather conditions.

[11] https://quickstats.nass.usda.gov/
[12] Science-based maize stover removal can be sustainable, Maecio R. Nunes et.al. Agronomy Journal, 2021; Vol. 113 page 3178-3192

Figure A-3. 10-year corn grain planted and harvested areas within the supply zone

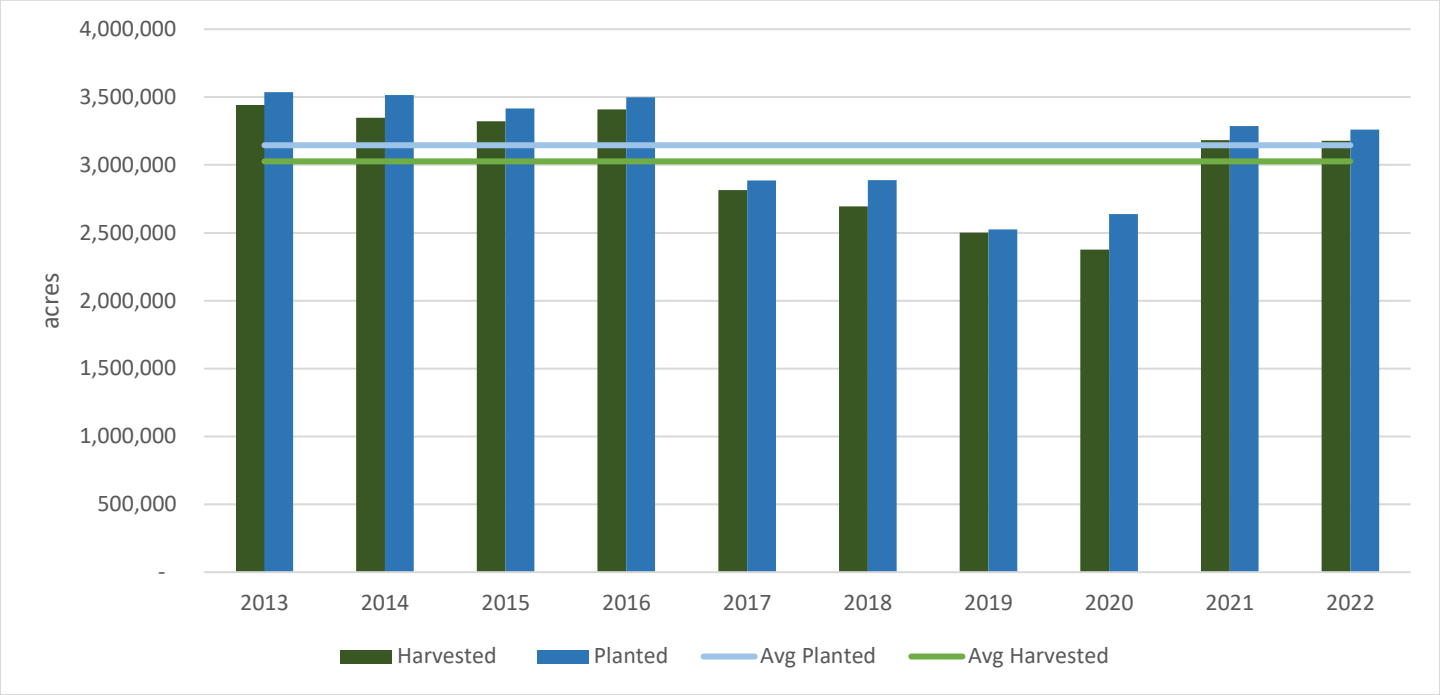


Table A-3 summarizes the average, 10-year low and high for Corn grain planted area, harvested area and yield.

Table A-3. Corn grain planted and harvested area and yield comparison over the period of 2012-2022

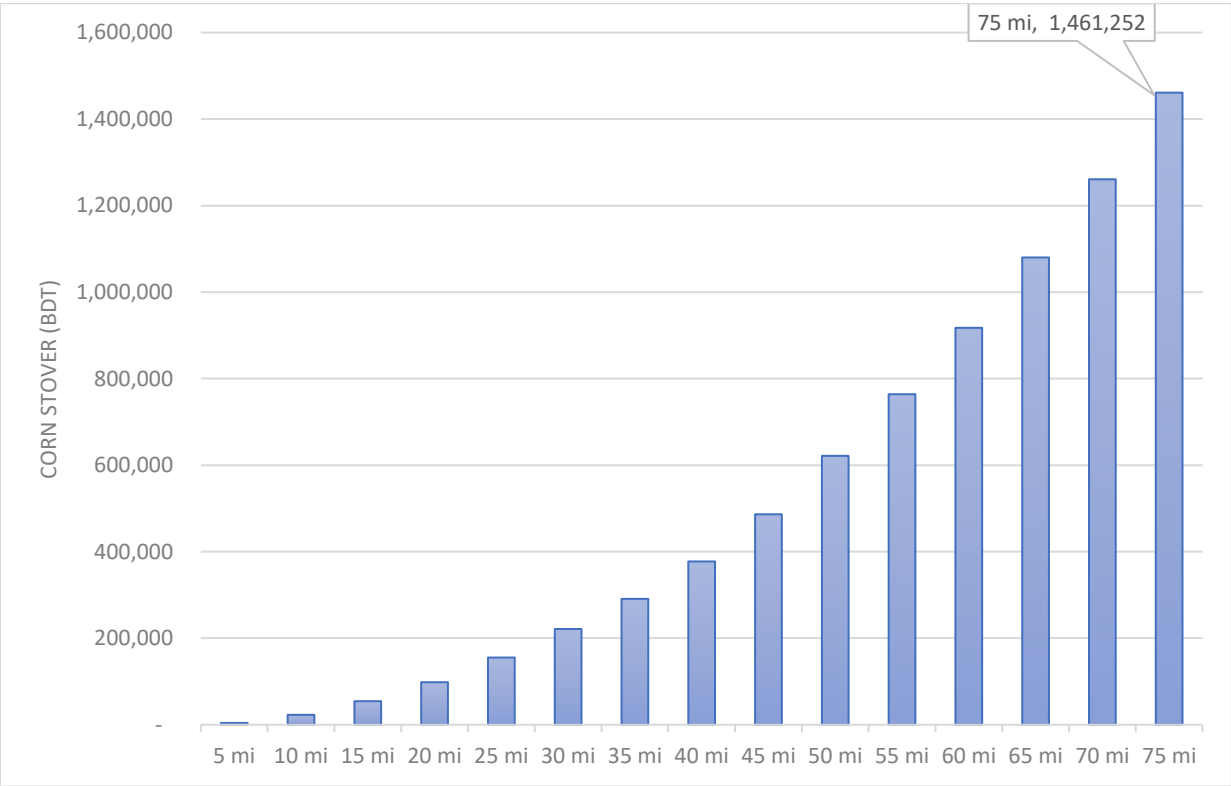
	2022 harvest season	10-year Average (2012-2022)	10-year low (2012-2022)	10-year high (2012-2022)
Planted Area	3,260,565	3,144,973	2,525,833	3,534,866
Harvested Area	3,178,360	3,026,189	2,376,740	3,435,936
Avg Grain Yield (bu/acre)	203	187	159	203

Low Risk Corn Stover Availability

Based on the historical production data, and after applying the harvesting constraints, the potential corn stover available to be harvested within the supply zone is estimated to be around 4,000,000 BDT/ year. However, this potential corn stover availability does not account for farm participation rate and Biomass Availability Multiple (BAM). As discussed before, not all crop growers in the region will be willing to participate in the biomass supply network for various agronomic, social and economic reasons. Thus, the total potential corn stover availability needs to be reduced based on the farm participation rate. In addition, not all the produced corn stover will be available for future biomass projects for reasons such as uncertainty in the length of harvest season, future competing demands, and labor/machine availability. This will be reflected in BAM. In this report, we assume 35% farm participation rate mainly due to the lack of experience in corn stover harvest among local growers, short and usually wet harvest window, resulting in a BAM value of 2.86. We expect higher farm participation rate when a commercial scale biomass project is up and running. However, we consider the additional farm participation rate (more than 35%) as a redundant biomass source in case of biomass supply shortage for the biomass facility.

Thus, the rated quantity for this BDO Zone is estimated to be 1,400,000 BDT/ year. Its availability is mapped in Figure A-3 below, in 5-mile increments from the center point (St James, MN). About half of the corn stover supply is available within a 55-mile radius.

Figure A-4. Sustainable removal quantity of corn stover by distance from St James, MN within the supply zone



Current Demand

Our research found one digestor at the edge of the supply zone (70mi from the center point) consuming a small quantity of corn stover, and no large-scale facilities within the 150-mile Competition Zone. There are a few growers that use corn stover for animal bedding, which is estimated to be less than 1% of the total generated in the supply basin. For this reason, there is minimal trade of corn stover bales in the region, no tracking of corn stover prices, as biomass or bale, and an understanding of pricing is limited. The estimated price for corn stover bales is derived from direct outreach to farmers. Therefore, based on our observations, we expect a majority of produced corn stover is currently unused and potentially available to new buyers.

Stove Logistics Costs

There are three distinct periods in the corn stover logistic operations:

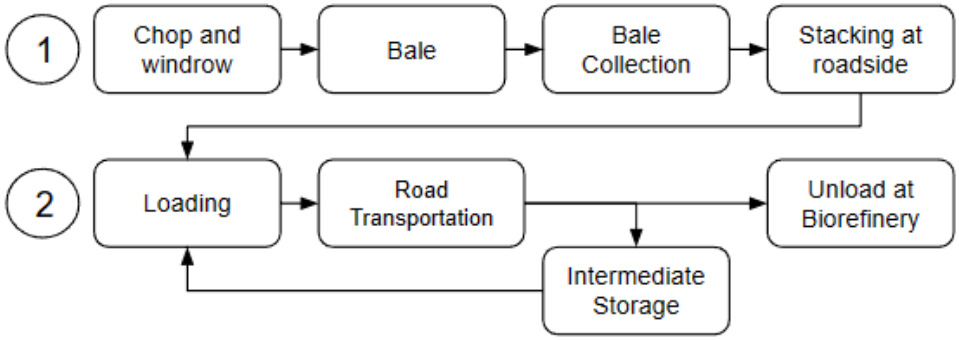
Harvest Season: The period immediately after grain harvest, when corn stover is chopped, baled, moved and stacked on the side of the field.

Roadside bale pickup and transportation: The window of time between grain harvest and corn planting season, when the bales on the side of the field are loaded, transported and unloaded either directly to the biorefinery or at an intermediate storage site for later delivery to the biorefinery.

Post harvest after planting: Bales have been removed from corn fields and may be at an intermediate storage facility for several months before being finally transported to the biorefinery. Well drained ground and tarps are recommended to protect from the elements and minimize dry matter loss.

Table A-4 below illustrates the different phases of the logistics of harvesting and transporting corn stover bales:

Figure A-3. Corn stover logistics operations[13]



The farm to gate cost estimation is based on Iowa State University's Extension and Outreach modelling[14] and takes into account nutrient deficiency (referred below as "material cost"), chopping, bailing, and edge of field stacking cost. The model does not account for the cost of covering the bale pile or a harvest coordination cost, which will be incurred when the project developer takes over the inventory. For this study, we assume material cost to be the nutrient equivalent of biomass removed from the soil, which discussed above.

Material Cost: $15/BDT

Flail Chopper Cost: $7-10/BDT

Bailing & Collection Cost: $25-35/BDT

Edge of field stacking Cost: $3-5/BDT

The farm-gate bale cost is estimated to be in a range between $50-65 per BDT, which is the sum of chopping, bailing and moving and stacking at the edge of the field. However, that is not the full price estimated to be paid to the farmer for the bale as outreach indicated that in order to compensate for the cost of opportunity, they would require a profit of at least $18/ acre, or $16/ bdt (assuming 3 bales per acres in this region). Therefore, the estimated farm-gate corn stover price ranges between $66-81/bdt.

Because there is no established market for corn stover in the region, determining market prices is challenging. The one data point used for reference is the small animal bedding market estimated to be less than 1% of all potential corn stover production, primarily made up of growers baling corn stover for their own animal bedding needs.

Prices tend to be higher when verbally indicated by farmers as opposed to the market, as sellers attempt to raise prices. However, in markets where very few farms are participating as biomass suppliers, pricing is unknown to many and therefore tend to be unrealistic, requiring education from the project developer.

[13] https://www.sciencedirect.com/science/article/abs/pii/S0306261917302878?via%3Dihub
[14] https://www.extension.iastate.edu/agdm/crops/html/a1-70.html

Transport Cost: The transport cost is calculated for an average drive distance of 50 miles for a supply radius of 75 mile at an average cost of $4.00/mile[15] (one way). The cost of loading and unloading is approximately $3.25/bale or $5.80/ton. However, from the outreach to transportation companies in the region, it is possible that there would be a charge per diem, in this case the figure provided was around $720 per half day, which is the minimum charge.

As shown in Table A-4, a standard 53' flatbed trailer can carry between 26 and 39 bales per load (depending on the bale size). For a commercial-scale biomass project, we expect the project developer uses large bales (in particular square bales) to minimize transportation and storage costs. Thus, assuming 39 bales with an average weight of 1,200 lbs., the payload is estimated to be about 20 dry ton. So, in this case, the transportation cost is estimated to be $20/bdt.

In summary, the estimated delivered cost is $95-108/bdt including farm-gate price ($68-81/bdt), transportation cost ($20/bdt) and loading/unloading ($7/bdt).

Table A-4. Bale load capacity configuration table16

Truck Configurations[a]	Load Limits		Payload		Maximum Load Bulk Density (DM lb/ft³)
	Length (ft)	GVW (lb)	Max (lb)	Square Bale Count	
(1) 48-ft flatbed trailer	48[b]	80,000[b]	51,100	24 – 4×4×8-ft 36 – 3×4×8-ft	16.6 – 4×4×8-ft 14.8 – 3×4×8-ft
(2) 53-ft flatbed trailer	53[c]	80,000[b]	50,800	26 – 4×4×8-ft 39 – 3×4×8-ft	15.3 – 4×4×8-ft 13.6 – 3×4×8-ft
(3) 24-ft flatbed tractor pulling two 30-ft flatbed trailers	105[d,e]	105,500[d]	59,500	44 – 4×4×8-ft 66 – 3×4×8-ft	10.6 – 4×4×8-ft 9.4 – 3×4×8-ft

[15] Cost estimates acquired through direct outreach to transportation companies, but are subject to change.

[16] a. Impacts on transportation costs for these configurations are discussed in greater detail in Section 2.3.2.2. b. Federal limits. c. Common state maximum on National Network (NN) highways. d. Allowable common limits in CO, ID, KS, ND, NE, OK, and SD for two trailing units on non-NN highways. e. Overall truck length limit. Actual load length is 95 ft

APPENDIX B: RISK INDICATOR SCORING METRICS

CATEGORY 1.0: SUPPLIER RISK

1.1 Risk Factor: Credit-Worthiness/Future Solvency of Suppliers

1.1.1 Longevity & History of Supplier Performance

Rationale: Number of years in business is a positive indicator of future solvency. Historical performance is an indicator of future performance.

Risk Information: The supply zone is one of the most productive corn regions in the United States. Corn growers have a very long history of operating in this region, where in the past 10 years the average harvested area has been 3,026,189 acres.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10. The expertise and experience of growers is well established in the supply zone.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

1.2 Risk Factor: Conflicts of Interest/Vested Interest with Competing Market(s)

1.2.1 Suppliers' Dependence on, or Preference for, Competing Markets

Rationale: Suppliers may have a vested interest or preference to supply to specific competitors for biomass feedstock. Preferences may be due to historical, long-term, or personal relationships, less stringent feedstock quality requirements, more flexible operating hours by competing markets, or supplier's dependences on competing markets to accept or purchase other products/by-products. During periods of feedstock shortage such suppliers may be more likely to allocate the scarce supply to a competitor resulting in supply disruptions for the Issuer.

Risk Information: There is minimal harvesting of corn stover among neighboring growers for the use in their own farms. There are no established markets and thus no preference among crop growers. The crop growers have no vested interests or preference to supply to specific competitors for biomass feedstock.

This risk indicator has minimal impact on future biomass projects due to the abundance of underutilized corn stover supply and lack of established markets.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**

Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

1.3 Risk Factor: Supplier Control Over Production and Transportation

1.3.1 Ownership of Land/Means of Production

Rationale: Suppliers that own land where feedstock is produced, or a production facility, tend to have better control of supply chains and present lower degrees of supply risk.

Risk Information: According to the USDA Census, there are approximately 16,908 farms in the supply zone (producing different agricultural products) with an average area of 264 acres. Producers are the landowners.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

1.3.2 Ownership of Equipment

Rationale: In most cases, suppliers which own or lease equipment for harvest, collection and processing feedstock are lower risk than those who are not. For example, third-party harvesting equipment may not be available when required. Short harvest windows may be missed if a farmer and contractor cannot schedule harvest times that are convenient and quantity shortages can result. However, in some circumstances reliance on third-party equipment to harvest or produce feedstock can decrease supply chain risk. For example, when harvesting agricultural residues such as corn stover, the use of a third-party company with standard equipment specializing in harvesting, collection and transportation may decrease quality variations (e.g., ash content) of final feedstock.

Risk Information: Currently, there is no commercial harvesting and collection of corn stover in the BDO Zone due to the lack of established market in the region, resulting in low field equipment ownership. A very low number of farmers own round balers for their own use.	
Raw Risk Likelihood (RRL) The risk likelihood is deemed *very high*, therefore the RRL is 10 out of 10.	**Score** **10**
Raw Risk Impact (RRI) The risk impact is deemed *very high*, therefore the RRI is 10 out of 10.	**Score** **10**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 100 out of 100.	**Score** **100**
Mitigation/Notching *RRL Mitigation (Notch)* The likelihood of this risk can be reduced by providing incentives such as offtake agreements and financing for the purchase of equipment, which would create a stable investment opportunity for farmers. However, even then, the likelihood of growers to invest in field equipment is low. Because there are no established incentives in place, there is no notching in this category. *RRI Mitigation (Notch)* Certain biomass projects may consider investing in the field equipment fleets, taking the responsibility of owning equipment away from the farmer. Other third-party operators can provide collection and bailing services; such arrangements would greatly impact the feedstock quantity available for a project. Therefore, this risk impact is notched at 25%. The Total Notch is (RRL Notch × RRI Notch) is 25%.	**Notch** **25%**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 75 out of 100.	**Score** **75**

1.3.3 Ownership of Transportation/Logistics

Rationale: In most cases, suppliers that own or lease transportation equipment necessary to transport biomass from forest or field are lower risk than those who do not. However, in some circumstances, reliance on third parties to transport biomass is common practice and does not contribute to risk.	
Risk Information: The limited bales traded in the supply region are typically transported in farm-operated tractor trailers or flat-beds over short distances. Despite outreach efforts, there are no bale transportation services in the region that could move commercial quantities of corn stover, leading to increased competition for existing transportation companies and potential delivery uncertainties. Acquiring dedicated transportation equipment by crop growers could mitigate this risk, but with growers already facing heightened operational costs and interest rates, the likelihood of widespread investment in this resource is low.	
Raw Risk Likelihood (RRL) The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**Score** **8**
Raw Risk Impact (RRI) The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**Score** **8**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**Score** **64**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 64 out of 100.	**64**

1.3.4 Feedstock as a Secondary Transformation

Rationale: A secondary transformation is dependent upon the production of primary products, e.g., forest residues, corn stover, bark, or sawmill chips (unless from a dedicated chip mill) are all secondary transformations of a primary product.

Risks are higher if feedstock is a secondary transformation of a primary, more valuable product. It may not be economical for suppliers to produce biomass on its own, in the absence of markets for the primary product. For example, a supplier may produce dimensional lumber as its primary product and wood chips as a by-product, therefore relying on the health of the housing market for production levels. If the demand for dimensional lumber drops, so can the availability of sawmill residues.

In case of agricultural feedstocks such as corn stover, the feedstock is a by-product of a primary crop. Since the primary crop is significantly more lucrative than the residue, it will be a priority for the producer. If production of the primary crop requires resources to be taken away from the production of secondary crop (e.g., in case of shorter harvesting windows due to weather), the secondary feedstock supply will suffer. In times of stretched resources, suppliers may also perceive harvesting and collection of the feedstock as a nuisance, potentially decreasing production levels.

Understanding the economic drivers for suppliers' primary product can help gauge risk levels for secondary transformation biomass products.

Risk Information: The region has a long history of corn production and has been one of the most productive corn regions in the United States with average yields in the last 10 years of 187bu/ acre. The demand for corn grain is stable and corn stover is not inevitable by-product of corn stover.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**2**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**2**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**4**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**

Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**4**

1.4 Risk Factor: Supplier Experience

1.4.1 Fundamental Feedstock Production Experience

Rationale: Risk is higher when suppliers have limited experience with planting/growing/harvesting/ processing and/or collecting biomass. Limited experience may be common for stover or forest residue supply chains where farmers or forestry producers may have no previous experience.

Risk Information: Despite the large amounts of corn stover (biomass in the fields) in the BDO Zone, there is a very small quantity of corn stover being harvested, estimated to be less than 1% of all biomass available, and used mainly for animal bedding. Suppliers use their own equipment to bale, and only enough to trade with the neighbors. Even though it would be possible to establish a commercial scale supply chain, albeit with sub-optimal efficiency and quality at first, the lack of established experience in corn stover harvesting and collection brings a high risk for future biomass projects.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 48 out of 100.	**48**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) Although there is no record of commercial harvesting and collection of corn stover in the BDO zone region by crop growers, we expect that with the establishment of biomass projects and creation of solid demands for corn stover in the region more farms will be interested to further engage in biomass harvesting and collection operations. We consider a 25% notching. *RRI Mitigation (Notch)* A custom service provider or an integrated operation could perform the bailing operations and such arrangement would lower the impact in the supply of quantity and quality as well as accelerate the knowledge transfer. Assuming the service provider is an experienced party, the lack of expertise from the corn grower can be greatly mitigated, therefore this category is notched at 50%. The Total Notch (RRL Notch × RRI Notch) is 63%.	**63%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 18 out of 100.	**18**

1.4.2 Production Scale Experience

Rationale: Scale-up entails risk. Risk is higher when suppliers has limited experience with the production of the quantity of feedstock required.

Risk Information: There is a very limited number of corn producers that bale corn stover to trade with neighbors. Their equipment and labor are not specialized or optimized for high efficiency. Scaling up the harvesting, collection, and transportation of corn stover with proper quality controls is a major challenge in this supply zone given that the starting point is non-existent.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very high*, therefore the RRL is 10 out of 10.	**10**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very high*, therefore the RRI is 10 out of 10.	**10**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 100 out of 100.	**100**
Mitigation/Notching *RRL Mitigation (Notch)* The knowledge accumulation is a slow process that happens in a combination of direct experience and training, which makes it challenging to train labors properly given the short harvest season. Extension programs and other potential training resources can expedite this process, however, the speed to mitigate the scale up risk of an entire supply zone is unlikely and therefore, this category is notched at 25%. *RRI Mitigation (Notch)* Selling the biomass to a third party that can come to the field and bale the corn stover can drastically mitigate the scaling risk impact in a project. Skilled operators that have experience harvesting in other regions can positively impact the entire supply chain, given that their resources are enough to cover the needs of a potential project within the supply zone. Therefore, this category is notched at 50%. The Total Notch (RRL Notch × RRI Notch) is 63%.	**Notch** **63%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 37.5 out of 100.	**37.5**

1.5 Risk Factor: Supplier Harvesting/Collection/Processing Capacity

1.5.1 Supplier's Equipment Efficiency

Rationale: Equipment efficiency significantly influences supplier's feedstock production capacity. Understanding supplier's equipment capability enables understanding of their ability to produce feedstock of suitable quality.

Risk Information: There are no suppliers of any size using field equipment for harvesting and collection. The few that do utilize round balers, do not produce high density bales, optimized for commercial scale volumes.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very high*, therefore the RRL is 10 out of 10.	**10**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 80 out of 100.	**80**
Mitigation/Notching *RRL Mitigation (Notch)* With the establishment of demand in the supply zone, it may create the incentive for farmers to buy or improve their equipment for higher efficiency. Therefore, this category is notched at 25%. *RRI Mitigation (Notch)* The introduction of a third-party service provider such as Pacific Ag, that will bring their own equipment for harvesting and collection operations, can significantly reduce the supply risk. Therefore, this category is notched at 50%. The Total Notch (RRL Notch × RRI Notch) is 63%.	**Notch** **63%**

Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 30 out of 100.	**30**

1.6 Risk Factor: Supplier Motivation

1.6.1 Feedstock Production Priority

Rationale: When biomass feedstock is a secondary or non-core line of business, or when it is a by-product or a residual from a more valuable primary product, then suppliers may not put in sufficient effort for consistent production. Risk of breach increases when production and/or delivery of feedstock compromises a supplier's ability to make a primary product. When biomass feedstock is a by-product of another main higher margin or main product (e.g., corn stover (e.g., corn) or forest residues (e.g., pulpwood)) supply may not be a top priority for a supplier.

Risk Information: Corn stover is a by-product that competes for corn grower's resources (i.e., time, machinery, and labor). In this region, crop growers tend to till the fields shortly after harvest to lower exposure to wet weather or frozen ground. This weather pattern creates a very short window for harvesting corn stover, estimated to be between 20 to 35 working days. Additionally, with the need to stack and store before the rain and snow, it increases the demand for resources. The lack of feedstock demand, and consequently, an established supply chain, means growers will have to divert resources into this endeavor. From the outreach conducted, the financial incentive would be the only motivating factor to drive participation rates up. Our modelling indicates pricing stacked at the edge of the field would range from **$68-81**/dry ton, depending on the crop yield that year, and the price of corn at the time.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**64**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) Every corn grower that wishes to engage in corn stover harvesting and collection will be required to divert resources to that operation. Willingness to participate is the mitigating factor, that can be achieved by appropriate pricing being offered by the buyer. Therefore, this category is notched at 25%. *RRI Mitigation (Notch)* When the underutilized biomass on the field becomes a sufficient source of income, corn growers will be incentivized to divert resources to this operation, however the pricing offered is outside their control and, based on outreach, that is the main factor of the decision. Therefore, because the impact mitigation is dependent on externalities, this category is not notched. The Total Notch (RRL Notch × RRI Notch) is 25%.	**25%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 48 out of 100.	**48**

CATEGORY 2.0: COMPETITOR RISK

2.1 Risk Factor: Influence on Feedstock Supply of Existing Markets

2.1.1 Competitor Locations and Overall Geographical Influence

Rationale: Competitors' locations relative to siting locations within a BDO Zone can affect the viability of procuring feedstock and the cost of that feedstock. Accurate and detailed competitor mapping provides an understanding of the geographical influence a competitor may have on new plants within a BDO Zone, including competitive advantages such as short hauling.

Risk Information: In Le Sueur, MN, 70mi NE from St James, there is one digestor consuming corn stover in quantities that would not significantly impact availability for a new bio-based facility. There is no large-scale competition or demand for corn stover bales in this supply zone.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**Score** **2**
Raw Risk Impact (RRI) The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**Score** **2**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**Score** **4**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**Score** **4**

2.1.2 Current and Historical Consumption of Feedstock Quantity

Rationale: Clear understanding of feedstock consumption by key competitors for each rated type of feedstock in the BDO Zone is essential to quantifying competitor risk.

Understanding current consumption and historical trends of feedstock utilization can provide valuable information about feedstock price elasticity during shortages, and insight into events that may impact future supply conditions. It can enable more accurate estimates of the sensitivity of feedstock availability to potential future consumption levels or to the impact of external events (e.g., weather events, structural economic changes, seasonality, or policy change).

Risk Information: There has never been commercial demand for corn stover in this supply zone. The market has not been developed to a point where trends are meaningful.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

2.1.3 Competitor Pricing and Price Sensitivity

Rationale: Understanding how much competitors pay (or receive) for different feedstock types is an essential step to determining competitiveness of Issuer and to accurate assessment of the delivered cost range in the BDO Zone rating.

Current and historical prices paid/received by competitors provide insight into their procurement behaviors and exert pressure on suppliers in the BDO Zone. Such as ability/willingness to pay premiums for feedstock during times of feedstock shortage or reduce prices (or cut off deliveries) during gluts. Competitors that have an ability to offer higher prices for feedstock during feedstock shortages can pose significant risk to Issuer.

Knowledge of competitor pricing and price sensitivity is also an essential prerequisite to formulating a feedstock cost curve which can enable predictions of feedstock redundancy, i.e., how much feedstock could become available at different pricing levels (see Category 3–Supply Chain Risk 3.1.3).

Risk Information: There is no up-to-date pricing available for a benchmark within the supply zone. Because this has never been a developed market, there is also no historical pricing. The few corn growers that are bailing, trade for other inputs, such as manure as a fertilizer, with neighboring farms. Pricing and price sensitivity in this supply zone will be dependent on grain farmers accepting the opportunity cost of removing nutrients from the soil (by sustainable harvest of the corn stover) plus a profit per acre, therefore, only a portion of the pricing will correlate to fertilizer replacement. The undeveloped corn stover market brings uncertainty about the price range developers will need to pay to incentivize growers to participate in the supply chain, therefore increasing risk.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

2.1.4 Impacts of Future Demand on Feedstock Availability and Price by Current Competitors

Rationale: Feedstock utilization in a BDO Zone can change over time. Expansion of feedstock demand by current competitors can put additional pressure on feedstock and can lead to higher prices, feedstock disruptions, shortages or supplier breach or other types of supply chain disruption.

If current markets for feedstock have been publicly signaling the potential for increased demand for feedstock (in the case of a sawmill adding a shift, or pulp mill potentially expanding into production of renewable chemicals, for example), high interest in a supply basin can make suppliers overconfident, leading to a supplier-controlled market where short-term contracting becomes the norm and supply chain reliability is compromised for the Issuer. If and when it occurs, increased demand on feedstock may decrease availability and increase cost for new plants within the BDO Zone.

Risk Information: At the time of this study, there is no large-scale demand for corn stover, nor any proposed biorefinery projects, apart from a digestor operating in Le Sueur, MN (70mi from St James) that utilizes corn stover. However, because this operation is at the edge of the supply zone and there are a large number of potential suppliers with significant quantity, it does not present a material risk for feedstock competition. Due to the large amounts of biomass available, not being collected and baled, the chances of shortages and supplier breaches due to competition are deemed very low.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

2.1.5 Soft Supply Influence of Existing Markets

Rationale: In some cases, existing markets for feedstock may be able to exert high degrees of pressure over local suppliers, effectively enabling control feedstock, especially during times of shortage. This control can derive from qualitative or "soft" factors such as long previous relationships between local suppliers and existing markets for feedstock.

Risk Information: The absent large-scale demand for corn stover means there is no established market for this biomass in the supply zone, which negates the possibility of influence in feedstock supply.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**2**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**2**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**4**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**4**

2.1.6 Temporary Market-Driven Markets

Rationale: Alternative, non-traditional, market-driven competitors for feedstock can drive feedstock demand in unusual circumstances. A BDO Zone Rating Issuer based on corn stover as a feedstock, for example, would not typically compete with higher-end animal feed markets due to quality issues. However, in times of significant hay shortage (e.g., during drought), farmers use corn stover in place of hay, driving the price of feedstock and decreasing availability for bio-projects.[17]

Risk Information: There are no non-traditional or market-driven markets for feedstock.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**2**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**2**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**4**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**4**

2.2 Risk Factor: Specific Competitors' Competitive Advantage

2.2.1 Relative Inventory Capacity

Rationale: The more inventory a competing biomass facility is able to store, the more competitively pressure it can exert on supply. Ability to store large inventories allows competitors to purchase inventory when the prices are low, potentially giving it an economic advantage. Additionally, the ability to store inventory during feedstock supply surpluses can enable competitors to continue to intake feedstock when the Issuers plant (with lesser inventory capacity) may be forced to put suppliers on quota. Larger inventory capacity on the part of competing markets thereby creates supplier loyalty and can make it more difficult for new projects to secure supply without paying a significant premium.

Risk Information: There is no commercial scale demand and therefore no inventory.

[17] Bergtold 2018.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**Score** **NR**
Raw Risk Impact (RRI) The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**Score** **NR**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is not rated.	**Score** **NR**
Mitigation/Notching The Total Notch (RRL Notch × RRI Notch) is not rated.	**Notch** **NN**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is not rated.	**Score** **NR**

2.2.2 Relative Accessibility/Delivery Hours and Wait Times

Rationale: The value attributed by suppliers to local competing markets for biomass is often directly related to the degree of flexibility the market provides in terms of delivery hours, and the more efficiently discharge can occur.

Risk Information: There is no established market and therefore this risk indicator is not relevant.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**Score** **NR**
Raw Risk Impact (RRI) The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**Score** **NR**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is not rated.	**Score** **NR**
Mitigation/Notching The Total Notch (RRL Notch × RRI Notch) is not rated.	**Notch** **NR**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is not rated.	**Score** **_NR__**

2.2.3 Relative Specification Advantages

Rationale: When choosing a market for biomass feedstock, suppliers not only look at price, but also at relative quality requirements or specifications. It is important to understand feedstock quality specifications for competing markets within the BDO Zone in order to accurately quantify the risk that competitors can exert on the Issuer's supply chain.

Risk Information: There is no commercial-scale demand for feedstock in the region, therefore quality and specifications cannot be used as a tool to pressure competitors.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**Score** **2**
Raw Risk Impact (RRI) The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**Score** **2**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**Score** **4**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment.	**Notch** **NN**

RRI Mitigation (Notch) No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).
Loaded RI Score **Score** The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100. **4**

2.2.4 Demand for Competitors' Products

Rationale: Increased demand for competitor's final product can cause an increased demand for feedstock by the competitor. For example, an increased demand for wood pellets due to high energy prices in Europe or for biofuels due to a favorable clean fuels policy can cause increased pellet/biofuel production by competing markets. Thereby driving demand for feedstock within a BDO Zone.
Risk Information: There is no commercial demand for corn stover.
Raw Risk Likelihood (RRL) **Score** The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10. **2**
Raw Risk Impact (RRI) **Score** The risk impact is deemed *very low*, therefore the RRI is 2 out of 10. **2**
Gross Risk Indicator (GRI) **Score** The Gross Risk Indicator (RRL × RRI) is 4 out of 100. **4**
Mitigation/Notching **Notch** *RRL Mitigation (Notch)* **NN** No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).
Loaded RI Score **Score** The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100. **4**

CATEGORY 3.0: SUPPLY CHAIN RISK

3.1 Risk Factor: Feedstock Availability

3.1.1 Biomass Availability Multiple (BAM)

Rationale: Biomass Availability Multiple (BAM) indicates the degree of redundancy in an Issuer's supply chain in relation to the rated quantity in the BDO Zone. BAM is the mean ratio of biomass feedstock available to a project, in relation to delivered cost, divided by the Issuer's mean rated quantity. BAM is a strong indicator of supply chain resilience when stressed by supply shortage and/or supplier breach. BAMs of 1.5 or higher are generally signals of lower feedstock risk for new projects in BDO Zones.
Risk Information: Not all of the produced corn stover will be available for future biomass projects for reasons such as uncertainty in the length of harvest season, future competing demands, and labor/machine availability. To achieve a low-risk level, supply redundancy is necessary, therefore we assume a BAM of 2.86 for this study, which means a BAM quantity of 1,400,000 BDT/year of corn stover.

Unforeseen biomass production and market factors such as farm participation rate, new competitors, weather events and economic conditions can have high levels of impact on our assumptions to calculate BAM and thus biomass availability.
Raw Risk Likelihood (RRL) **Score** The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10. **4**
Raw Risk Impact (RRI) **Score** The risk impact is deemed *high*, therefore the RRI is 8 out of 10. **8**
Gross Risk Indicator (GRI) **Score** The Gross Risk Indicator (RRL × RRI) is 32 out of 100. **32**
Mitigation/Notching **Notch** *RRL Mitigation (Notch)* **NN** No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).
Loaded RI Score **Score** The Loaded RI Score ((1-Total Notch) × GRI Score) is 32 out of 100. **32**

3.1.2 Feedstock Supply Curve/Marginal Cost Curve

Rationale: The greater the feasible transport distance, the more feedstock is accessible to the Issuer, but at a higher delivered cost. The feedstock supply curve, sometimes referred to as the marginal cost curve, is a function of feedstock availability over its cost which is primarily, but not exclusively, a function of distance. The feedstock supply curve is used to determine the availability of redundant feedstock at various price points, and the cost of replacing feedstock with substitutes located at different distances.

Feedstock cost curves are useful in determining supply chain resilience; they provide information about the cost of feedstock availability in times of supply disturbance. Biomass supply chains are prone to supply disturbances over time; suppliers can become insolvent, or weather events can temporarily disrupt feedstock availability. When a disturbance occurs, the Issuer may need to source replacement feedstock from different suppliers at different locations and costs. A biomass supply curve indicates quantities of feedstock available at various price levels from suppliers generally located further away than core supplier.

Risk Information: A supply curve illustrating the availability of corn stover based on distance can be found in Figure A-4. The supply curve does not represent actual corn stover biomass availability, rather it illustrates an estimation of potential within the supply zone. There are large amounts of potential corn stover around the center point of the BDO Zone, however, the limited information from farmer outreach and the difficulty in pinpointing where the actual supply would come from creates a challenge for calculating the marginal cost impact of increased supply distances. Our modelling estimates that that almost 50% of the biomass potential in the supply zone could be available under 55 miles.

Direct outreach to potential suppliers within the Supply Zone for a specific project that can offer a factual price for biomass will change the dynamic of the market and offer a more detailed understanding of where biomass can be sourced.

Raw Risk Likelihood (RRL) **Score** The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10. **6**

Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 24 out of 100.	**24**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100.	**24**

3.1.3 Seasonal Feedstock Supply Variation

Rationale: Biomass supply can present significant seasonal supply variations. Seasonal supply variations combined with limitations associated with longer-distance transportation and storage can lead to BDO Zone biomass supply imbalances[18] and can manifest in shortages and higher costs for Issuers.

Risk Information: Corn stover is only available after corn harvest, which occurs in late September through October, consequently, all corn stover must be harvested and stored within 20-30 working days. Weather can impact the collection and baling window, potentially affecting the quantity and quality of feedstock, specifically moisture, which at this time of the year in the BDO zone, does not dry fast enough. Chart C-5 shows the 10-year precipitation for the month of October in the supply zone, and although the trend is downward, precipitation has been erratic and may be unpredictable for planning biomass collection. Optimizing harvesting and field operations can mitigate part of the risk.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 48 out of 100.	**48**
Mitigation/Notching *RRL Mitigation (Notch)* It is not possible to mitigate this category. *RRI Mitigation (Notch)* Inventory management can greatly lower the supply risk to a biorefinery. However, there is a limit to storing agricultural biomass due to the dry matter loss and fire risks Therefore, this category is notched at 25%. The Total Notch (RRL Notch × RRI Notch) is 25%.	**Notch** **25%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

[18] Golecha & Gan 2016.

3.1.4 Year-to-Year Variation in Feedstock Availability

Rationale: Biomass can have significant year-to-year supply variations due to variability in yield from biomass harvesting operations, particularly with agricultural biomass.

Risk Information: Variability is the nature of annual crops with weather being the main factor, followed by market prices. Over the past 10 years this supply zone has harvested 96% of the planted area and is one of the most productive in the country, therefore, seasonal feedstock supply variation is unlikely from a production perspective, however weather patterns at the end of the harvest season can impact grain farmer's planning of tilling, possibly rendering part of the corn stover inaccessible. Often one factor offsets the other, so total supply remains relatively stable – bad weather reduces production, driving up prices, making farmers decide to plant corn in the next season, however the corn stover harvesting season is short and can be impacted by weather even after grain harvest. Figure A-3 shows the total planted and harvested corn in the supply zone with a 10-year average harvested area of 3,026,189 acres. BAM is used to lower risks associated with normal variations in feedstock availability, therefore the low-risk rated quantity takes into account the weather risk.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

3.2 Risk Factor: Historical Issues

3.2.1 Historical Feedstock Price Variations

Rationale: If volatility is shown in the historical feedstock price, then the risk of future price fluctuation is elevated. If feedstock prices have historically exceeded the price at which the Issuer would have to cease operations or breach a financial covenant (i.e., the "red line" feedstock cost), then mitigation measures should be put in place.

Risk Information: There is no historical price data for corn stover in the supply zone. Growers have no benchmark to create ask prices in a commercial supply operation, and are required to be educated on the revenue potential for their biomass/ corn stover bales. Corn stover bale price drivers include: demand, cost of collecting, baling and transportation, nutrient replacement and a profit per acre. Due to the novelty of this operation within the supply zone, price variation may be significant in the early stages of establishing a supply chain, while suppliers are getting familiarized with cost of opportunity. This situation increases risk for this category.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**

Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**64**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* Organizing outreach events and explaining the benefit of the sustainable removal of corn stover by conducting field trials is expected to enhance the understanding of the value of corn stover removal for crop growers, facilitating the establishment of reasonable pricing for corn stover in the early stage of the project deployment. We consider 50% notching. The Total Notch (RRL Notch × RRI Notch) is 50%.	**Notch** **50%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 64 out of 100.	**32**

3.2.2 Low Historical Demand for Feedstock in the BDO Zone

Rationale: If Issuer BDO Zone does not have history of developed, large-scale feedstock procurement, suppliers may not have sufficient expertise in feedstock production to ensure reliable supply, especially in early years. This can be particularly true for forest residues where typically the infrastructure for collection, processing and delivery is immature.

Where supply chains are not well-established, risk can be mitigated when new bio-based plants control a higher degree of feedstock processing. For example, if a BDO Zone rating is issued for clean wood chips and the historical demand in the Zone has been exclusively for pulpwood, then supply chain risk will be decreased for new bio-based plants that intake of pulpwood and manage log debarking and chipping internally. Rather than requiring inexperienced suppliers to deliver debarked wood chips.

Risk Information: The supply zone has no history of commercial-scale corn stover demand, therefore, suppliers do not have expertise in feedstock harvesting and logistics. Demand for commercial scale corn stover bales in the supply zone will only be achieved once a credible project is established with stable biomass demand.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**64**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* The ability of an experienced third-party custom harvest group to reliably supply a bioprocessing facility significantly reduces the risk of the operation. Therefore, this category is notched at 50%. The Total Notch (RRL Notch × RRI Notch) is 50%.	**Notch** **50%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 32 out of 100.	**32**

3.2.3 History of Production/Feedstock is a New/Secondary Crop or a Byproduct

Rationale: If feedstock is a new/secondary crop or a by-product, suppliers may either lack sufficient experience to mitigate risk, or be unable to react to such risk. Secondary crop or by-product producers may be less likely to prioritize production.

For new crop types, inexperience in planting, harvest, collection, and yield data may pose higher levels of risk.

If feedstock is a secondary transformation (i.e., wheat straw, corn stover or forest residue), then production can be subject to variables beyond suppliers' control (e.g., changing demand for sawtimber, or primary crop prices).

Risk Information: Corn stover is a byproduct of corn production, and its biomass potential availability depends on the number of corn acres harvested. Because of robust demand for grain corn, the outlook for production is stable, therefore maintaining the corn stover potential in the BDO Zone. However, grain producer's main concern is increasing their primary crop's yields year-over-year, and the novelty of removing organic matter from their soil, or having to wait longer periods for tilling, may play a deciding factor affecting participation rates. Due to this uncertainty, there is increased risk.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

3.3 Risk Factor: Non-Weather Based Externalities

3.3.1 Diesel, Oil and Producer Price Index (PPI)

Rationale: Diesel, oil, and PPI can impact feedstock cost of harvest and collection over time. Sensitivities to worst case scenarios should be run.

Risk Information: Diesel/oil price and the Producer Price Index (PPI) affect the biomass and the delivered cost of corn stover. Diesel price affects planting, harvesting, baling, and transportation costs directly. The PPI index affects baling and transportation costs indirectly, through labor costs. According to EIA data, in the past 10 years diesel pricing in the Midwest has increased by 32.4% in real terms (adjusted for inflation). According to the Bureau of Labor Statistics, the PPI variation in the same period was 25%. With inflation expected to remain high for the next few years, costs are expected to be affected across the supply chain. Since diesel and PPI are a reflection of the entire economy and not a competitive advantage, all sectors are affected by their change.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**

Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 24 out of 100.	**24**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100.	**24**

3.3.2 Currency Risk

Rationale: Where feedstock is purchased in a currency different than that which a new bio-based plant with locate in a BDO Zone, currency exchange rates and volatility can constitute risk exposure. BDO Zones that cross the US-Canada border, for example, which intake feedstock from both countries are exposed to such currency risk.

Risk Information: None of the feedstock would be sourced from or sold to outside of the region, and therefore there is no currency risk.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**NR**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**NR**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is not rated.	**NR**
Mitigation/Notching	**Notch**
The Total Notch (RRL Notch × RRI Notch) is not rated.	**NR**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is not rated.	**NR**

3.3.3 Border Risk

Rationale: Where feedstock is transported cross-border to another country, risk exposure to border closures and crossing delays becomes present. The availability of trucks willing to do cross-border runs is limited, which can decrease supply chain flexibility and resilience. Plants near the US-Canada border which intake feedstock from both countries are exposed to these risks.

Risk Information: None of the feedstock would be sourced from outside of the region, therefore there is no border risk.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**NR**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**NR**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is not rated.	**NR**

Mitigation/Notching	**Notch**
The Total Notch (RRL Notch × RRI Notch) is not rated.	**NR**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is not rated.	**NR**

3.3.4 Temporary Externality-Driven Markets for Feedstock

Rationale: Alternative, non-traditional, externality-driven competitors for feedstock can drive feedstock demand (and cost) in unusual circumstances. For example, an Issuer using corn stover as a feedstock would not typically compete with the higher-end animal feed market. However, in times of significant hay shortage (e.g., during drought), farmers may use corn stover as hay replacement, driving the price of stover feedstock and decreasing its availability for bio-projects.[19]

Risk Information: Livestock farming is not a relevant agricultural practice in this region and no non-traditional and externality-driven markets for feedstock were identified in the supply zone.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.4 Risk Factor: Risks Related to Feedstock Production, Harvest and Collection

3.4.1 Harvest & Collection Practices & Schedules

Rationale: Differences in harvest timing and practices used can create risk to both the quantity and quality of feedstock. For example, feedstock harvested by different suppliers in different windows can undergo varying levels of exposure to sun, wind, and moisture, leading to variations in delivered feedstock quality.

For example, agricultural feedstocks and energy crops have optimal harvesting windows to ensure minimal moisture content. In certain BDO Zones these harvesting windows may coincide with heightened weather risk such as frost or rain.

For forestry biomass, unsightly clear cuts, and slash piles (even on plantation forests and especially when located near communities) can provoke unwanted public backlash even when suitable and sustainable replanting regimes are followed.

[19] Bergtold 2018.

Risk Information: Corn stover has a short harvest window between late October and November that requires intense use of resources. Bales are usually stacked by the side of the field and are required to be moved no later than April, either to the biorefinery or to a secondary storage location. Additionally, wet weather can negatively affect the harvest operation and the quality of the bales because they don't dry in this season.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**64**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* An experienced custom harvest group can significantly reduce the feedstock supply risk to a bioprocessing facility therefore, this category is notched at 50%. The Total Notch (RRL Notch × RRI Notch) is 50%.	**Notch** **50%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 32 out of 100.	**32**

3.4.2 Harvesting & Collection Equipment

Rationale: Different types of harvesting and collection equipment used by suppliers in a BDO Zone can have a significant impact on the quality and availability of feedstock. Use of different types and combinations of harvesting, collection and processing equipment among suppliers can lead to non-homogeneous feedstock. Equipment that is not designed specifically for biomass cultivation, harvesting and collection, can increase feedstock quality risks.

Relevant equipment should be specified for the sake of product consistency and risk reduction.

Risk Information: The few growers that bale for bedding currently use round balers because they are cheaper to acquire and require less maintenance than the high-density square balers. The supply zone does not presently have sufficient quantities of specialized equipment necessary to supply large volumes.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**64**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* An experienced third-party baling company or a vertically integrated bio-project that uses their own equipment will significantly reduce the risk of feedstock supply. Therefore, this category is notched at 50%. The Total Notch (RRL Notch × RRI Notch) is 50%.	**Notch** **50%**

Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 32 out of 100.	**32**

3.4.3 Variation in Densification Methods Among Different Suppliers

Rationale: The shape and density of the unit in which feedstock is supplied can impact feedstock cost and quality. Standard feedstock densification modes for biomass consist of round or square bales, pellets, cubes, chips, or grindings. The size of wood fiber processed in a grinder is less homogenous than if a chipper is used.

Bales of different densities can absorb moisture at different rates. In certain cases, round bales have been viewed as problematic due to their uneven moisture content distribution.[20]

Risk Information: The optimal standard for a biorefinery to receive corn stover is high density square bales with weight ranging between 1,100lbs and 1,300lbs. To achieve the high density, suppliers must operate high efficiency square balers, however this equipment requires a substantial financial investment. Due to the lack of commercial scale operations in the supply zone, there are no quality standards to compare among suppliers. Biorefineries prefer operating with square bales, both for logistics and handling efficiency but also due to safety (compared to round bales that can move and hard to stack). The uncertainty about the homogeneity of feedstock being supplied increases the risk.

An anchor bio-processing facility may put in place financial and contractual incentives for growers to acquire equipment, and through education and/or training, it would also be likely to influence the optimal quality and standards, however such incentives are not common practice in the industry.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**64**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* A vertically integrated bio-project or hiring an experienced custom harvest group can significantly decrease variability in the feedstock quality and supply. Therefore, this category is notched at 50%. The Total Notch (RRL Notch × RRI Notch) is 50%	**50%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 32 out of 100.	**32**

3.4.4 Availability of Labor for Feedstock Production

Rationale: Skilled labor shortages can be difficult to remedy in the short-term. Availability of suitable labor in an area can impact the ability to procure sufficient feedstock quantities on required schedules. Labor risks are higher where supply chains are not yet active; or for Issuer's for whom large feedstock requirements, or development of new (or expanded) supply chains, demand significant additions to the local labor force.

[20] Huhnke 2018.

Risk Information: Labor for corn stover collection and transportation is needed for 4 to 6 weeks of the year. During harvest; however, the number of trained baler operators is low within the supply zone, understandably, due to a current lack of markets for corn stover and an underdeveloped supply chain. Additionally, from outreach to Extension programs, farms have seen a decreasing number of available labor and the ones that are left demand ever higher wages. The lack of trained baler operators in the region and the amount of time it would take to acquire and perfect the skills for this operation poses an immediate risk, as well as the optimization of efficiency and downtime minimization.	
Raw Risk Likelihood (RRL) The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**Score** **8**
Raw Risk Impact (RRI) The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**Score** **8**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**Score** **64**
Mitigation/Notching *RRL Mitigation (Notch)* Having a project developer or university extension programs offer training for suppliers can somewhat mitigate this risk, however, the time available for practical experience is short and perfecting this skill would be a medium-term effort. Only 25% notching is considered. *RRI Mitigation (Notch)* Importing temporary labor from other regions as well as contracting a third party for harvest and collection or by provision of similar services through a vertically integrated bio-project can significantly lower the labor risk, therefore this category is notched at 50%. The Total Notch (RRL Notch × RRI Notch) is 63%.	**Notch** **63%**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100.	**Score** **24**

3.5 Risk Factor: Transportation

3.5.1 Feedstock Transportation Costs

Rationale: Transportation can be one of the most significant cost components of biomass supply chains. The average transport cost and percentage of total feedstock cost attributable to transport should be known.

Transport distances of 80-120 km for biomass feedstocks are typical but larger distances can be common. Where average transport distance from suppliers to Issuer is high, the supply chain is subject to greater sensitivities to risks, such as increases in diesel cost, weather impacts, mechanical breakdown, and by the demand for scarce feedstock from competitors closer to the source.

Understanding average transport distance can help flag higher-risk BDO Zones where transport distance materially exceeds the average.

Risk Information: This study estimates that transportation costs make up approximately 18% to 21% of the total feedstock delivered cost. It is observed that even a relatively slight increase in the average transport distance can result in a substantial expansion of the feedstock supply basin, as demonstrated in the supply curves. However, there is not a substantial impact on the delivered price of feedstock due to marginal increases in the transportation costs. The supply zone for this study is defined as a 75-mile drive distance from the center point (St. James, MN). According to the theoretical supply curve found in Figure A-3, there is enough potential biomass to fuel a biorefinery under 55-mile drive distance. Therefore, the impact of increased drive distance to delivered cost is low.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

3.5.2 Diesel Cost Impacts

Rationale: Changes in diesel cost impact transport cost over time. Sensitivities to worst case scenarios should be run.

Risk Information: According to the IEA, Midwest No.2 diesel prices fluctuated from US$3.86/gallon in September 2013 to US$4.44/gallon in September 2023 in nominal terms. In real terms (adjusted for inflation using CPI), the diesel cost fell around 12% in this period. Diesel prices can fluctuate in the short term, which affects the entire supply chain. However, according to the IEA data, diesel prices have been on a slight downward trend. Short-term changes in diesel prices can exert pressure on operational margins however, the likelihood of the price change being significant enough to pose a substantial risk that can affect operations is low. However, diesel fuel is needed for all logistics operations, thus, the change in fuel price can have a significant impact on the delivered cost, though temporarily.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 6 out of 10.	**Score** **6**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 24 out of 100.	**Score** **24**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **N.A.**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100.	**Score** **24**

3.5.3 Transportation of Feedstock Requires Specialized Equipment

Rationale: Requirements for specialized transport equipment (e.g., walking-floor trailers) can increase supply chain risk. Where there is low availability in required transportation equipment, equipment owners have increased leverage over transportation prices and supply chain resiliency can be lower.

Risk Information: Handling of the bales for loading and unloading can be done using various implements on the tractor, such as wheel loaders or using skid steer loaders that are common in farming operations. However, road transportation of corn stover bales is done by flatbed trailers, which although quite common, are not available in sufficient numbers to transport commercial quantities of corn stover. A surge in demand for this type of truck would create competition and increase prices, increasing the risk of feedstock supply.

The developer can work with transportation companies operating in the supply zone to create incentives for expansion of their fleets. However, acceptance and the scale of such expansion is unknown at this point, therefore, no mitigation is possible.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**Score** **8**
Raw Risk Impact (RRI) The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**Score** **6**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 48 out of 100.	**Score** **48**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 48 out of 100.	**Score** **48**

3.5.4 Delivery Routes through Local Communities

Rationale: Transportation of biomass can become a nuisance to local communities, especially if a large number of trucks pass through residential and school areas. Local communities often have power to force regulations regarding truck transport, impeding the ability BDO Zone suppliers to transport feedstock.

Risk Information: Corn stover bales will be sourced at the farms and transported either directly to a biorefinery or an intermediary storage facility. Minnesota State Highway 68 (MN 68) is a 141.026-mile-long (226.959 km) highway that runs an east–west route in southwest and south-central Minnesota. The highway is adjacent to this study's industrial site in New Ulm. Either way, the routes for delivering biomass are mostly rural and unlikely to go through local communities.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.5.5 Transportation Regulations & Local Weight Limits

Rationale: In many BDO Zones, transportation is regulated based on seasonal road conditions. These regulations (e.g., "frost laws") often take the form of weight restrictions or limits on the number of trucks allowed on roads. Such regulations can impede the project's ability to source sufficient feedstock or increase the cost of doing so at certain times of the year.

Risk Information: In Minnesota, unpaved roads are designated as 9-ton (20,000 lbs.) per axle routes, while paved roads are 10-ton (22,000 lbs.) per axle routes, unless otherwise indicated by posted signs specifying lower weight limits. Seasonal restrictions, determined by the Commissioner of Transportation, dictate that the weight on any single axle must not exceed 5 tons (11,000 lbs.) on unpaved streets or highways and 10 tons (22,000 lbs.) on paved streets or highways.

In Iowa, a permit is required if the vehicle's gross weight exceeds 35 tons (80,000 lbs.). Permits allow a maximum individual axle weight of 9 tons (20,000 lbs.) per axle.

Both Minnesota and Iowa permit vehicles transporting raw agricultural goods to exceed their registered weight by up to 25%.

Seasonal weight restrictions for transportation in this supply zone is common and applies to all types of highways in the two states. Additionally, agricultural goods can be transported with increased weight loads. In addition, regulations and weight restrictions are a known quantity in this supply zone and affect all supply chains equally, therefore this risk factor is not a competitive disadvantage.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.5.6 Road Infrastructure

Rationale: Feedstock cost and availability can be a function of road infrastructure, in particular the accessibility the infrastructure provides to feedstock. Issues with road networks will translate directly to risks to feedstock supply.
Risk Information: According to a U.S. News & World Report study, Minnesota was ranked #2 for transportation infrastructure while Iowa was #34.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**Score** **2**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 8 out of 100.	**Score** **8**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 8 out of 100.	**Score** **8**

3.5.7 Transportation Redundancy

Rationale: Transport equipment redundancy is important for dealing with seasonally variable feedstock supplies as well as the risk of equipment breakdowns.
Risk Information: The most widely used method of transporting bales is with flatbed trailers. This equipment is inexpensive and very common both in farming operations and transportation companies. Based on the low-rated quantity of 1,400,000 bdt/year, and assuming 39 bales with an average weight of 1,200 lbs. (payload of about 20 dry ton, around 70,000 truckloads would be necessary to move all this material from fields. If analyzing a potential biorefinery with a demand of 200,000 dry tons/year, around 10,000 truckloads would be necessary to move all the feedstock, or 29 loads per day on a 350 day/year operation. Although flatbeds are widely used by farming and transportation companies alike, the region does not currently present an established infrastructure to transport large quantities of bales and it is likely that the feedstock delivery will be negatively impacted by competing with the current demands, while transportation infrastructure is being built.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**Score** **8**
Raw Risk Impact (RRI) The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**Score** **8**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**Score** **64**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) A reputable biorefinery operator can influence suppliers and transportation companies to invest in additional transportation equipment and overtime create redundancy, however that is a medium-term solution and therefore, notched at 25%. *RRI Mitigation (Notch)* Using multiple existing transportation companies and/ or owning part of the transportation equipment can mitigate the redundancy risk, however this requires a significant capital investment and time, therefore, this category is notched at 25%. The Total Notch (RRL Notch × RRI Notch) is 44%.	**44%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

3.6 Risk Factor: Supply Chain Resiliency

3.6.1 Size, Number and Location of Suppliers

Rationale: In general, a supply portfolio involving multiple suppliers of various sizes (and from multiple BDO Zones) is important for ensuring steady and uninterrupted feedstock supply with minimal price fluctuations. If a small number of large suppliers provides a high proportion of total feedstock, a disruption or supplier breach will have greater impact on the supply chain. In such cases the risk of disruption is lower, but the impact of those disruptions is higher. Conversely, many small suppliers are less likely to have the capacity to withstand internal disruptions and thus may be more likely to breach. Here, risk of disruption is higher, but their likely impact is lower. The number of suppliers as well as the ratio of small to large suppliers should be optimized.

There is no pre-determined number or optimal ratio of suppliers, although having too many or too few can both pose higher degrees of risk.

Risk Information: Corn stover supply chains are fragmented by nature due to the sheer numbers of farms involved in supplying feedstock. There are around 16,908 farms within the supply zone, however at this point the willingness of farmers to participate is an estimation and will only be fully known once a reputable operator establishes a plant in the region. The uncertainty about number and location of suppliers increases risk. However, as shown in Figure A-4, more than half of the corn stover supply is available in 55-mile radius.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) It was identified through outreach that the reputation of the biorefinery as well as that of the baling operator (if a third party) plays an important role in the establishment of the supply chain. Convincing farmers that they should participate in the biomass supply is an integral mitigating factor in this risk category, however that can only be achieved in a combination of the correct pricing for their feedstock.	**63%**

Because there are several alternatives and sources of biomass in the supply zone, with ample time for establishing trust among the supply chain prior to operations, this category is notched at 50%. *RRI Mitigation (Notch)* Identifying the optimal mix of size and location of suppliers and planning the coordination of multiple sources will create redundancy in the supply chain. However, this is a complex endeavor and therefore, this category is notched at 25%. The Total Notch (RRL Notch × RRI Notch) is 63%.	
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 13.5 out of 100.	**Score** **13.5**

3.6.2 Suppliers Subject to Same External Risk Factors

Rationale: When a single risk event can impact the feedstock production ability of all (or most) suppliers, then feedstock risk is higher and supply chain resiliency is lower. Resilience is maximized when biomass supply chains exhibit diversity in spatial location (i.e., geography), production practices and other elements of supply chain structures such that the impact of single high-risk events have varying impacts on suppliers.

Risk Information: The 10-year average harvested area for corn in the supply zone is 3,026,189 acres. In the same time period, corn prices fluctuated to a high of $7.63/bu in 2012 to a low of $3.12/bu during the pandemic in 2020, however the period's average has been $4.68/bu. The 10-year average yield for the supply zone is 187 bu/acre, one of the highest in the country. Demand for corn from energy or food and animal feed is very strong, reflected by the very large amount of land dedicated for its production. Since corn stover is a by-product of this crop, and based on the historic averages for the supply zone, it is safe to say that availability is resilient against external disruption. However, variation in prices and weather patterns may be the external factors that most impact biomass availability. Because of the vast supply zone, it is unlikely that external risk factors will disrupt the supply chain.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

3.6.3 Land Ownership Structures

Rationale: The ownership (or control) of the land base on which feedstock is produced can have significant impact on Issuer's feedstock risks. Risk of long-term variation in stumpage cost for wood fiber (i.e., the cost that one pays to a landowner for the right to cut and purchase their wood fiber) for example are much higher in the US where >90% of

the land is private, and thus stumpage cost is determined on a competitive auction basis. Conversely, in Canada >90% of the land is owned by the Crown and stumpage is allocated by the government.
Risk Information: Corn production in the supply zone is done by the crop growers who decide about their corn stover sales, regardless of being the land owner.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

3.7 Risk Factor: Climate and Natural Risks

3.7.1 Seasonal Weather Impacts on Feedstock Supply

Rationale: Seasonal weather impacts are defined as those deriving from natural weather variations (i.e., spring thaws, rainy seasons, or dry seasons – as opposed to from singular weather events like fires, droughts, or hurricanes). Seasonal weather changes can be a significant risk factor affecting feedstock availability, quality, and price. Given the major influence that weather has on multiple aspects of growing, harvesting, and transporting biomass, it is difficult to predict the availability of biomass at a specific location at different points in the future with a high degree of certainty. However, it is still possible, using past data and statistical models, to generate reasonable upper/lower bound estimates of biomass production in any given year in a wider supply basin. Such estimates are important in assessing feedstock risk and enable accurate assessment of the efficacy of Issuer's mitigation methods.
Risk Information: Weather can negatively influence corn production and thus the availability of corn stover year-over-year. In the past 10 years the supply zone has harvested an average of 96% of the planted area, with average yield of 187 bu/acre. Our outreach has found that the new corn varieties have proven even more resilient to drought in the 2023 harvest season. However, weather can play a significant role after harvest during the short collection window for corn stover, and represents an increased risk. The precipitation for the month of October in the supply zone has shown to vary greatly as illustrated in Chart C-5, from 4.97 inches in 2017 to 0.43 inches in 2022. If the soil is too wet it affects the ability of equipment to bale and the quality of the bale itself due to moisture in a season where it does not dry fast enough. In Iowa, the baling season can be mildly extended into December if weather becomes an issue. Additionally, the weather may force grain farmers to till the fields before baling can take place, impacting the corn stover availability.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**Score** **6**
Raw Risk Impact (RRI) The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**Score** **6**

Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

3.7.2 Long-Term Weather and Climate Trends

Rationale: In certain BDO Zones, climatic trends and significant potential changes to future weather patterns can create feedstock risk.

Risk Information: According to the Minnesota Palmer Drought Severity Index between 1895 and 2015 there has been no drought increase. The NIDIS (National Integrated Drought Information System) reports that over the last century, precipitation trends in the Midwest have been moving towards wetter conditions and fewer droughts than the region experienced in the early 20th century. The Department of Natural Resources states that Minnesota has warmed by 3.0 degrees F between 1895 and 2020, while annual precipitation increased by an average of 3.4 inches. According to NOAA, Iowa temperature has risen more than 1.0 F over the last century, concentrated over winter and fall, with no change in summer temperatures. Precipitation in the State has been above average since 1990, positively affecting agriculture by maintaining soil moisture, but eventually delaying spring planting. Long term climate trends do not seem to negatively impact corn production, yields or farming operations.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.7.3 Forest/Crop Fire

Rationale: Forest/crop fires, especially when occurring at large-scale, destroy feedstock and create shortages.

Fire-prone conditions are predicted to increase across Canada. This could potentially result in a doubling of the amount of area burned by the end of this century compared with amounts burned in recent decades. Boreal forests, which have been historically greatly influenced by fire, will likely be especially affected by this change.

Other climate change impacts that could add damaged or dead-wood to the forest fuel load (e.g., as a result of insect outbreaks, ice storms or high winds) may increase the risk of fire activity. New research is aimed at refining these climate change estimates of fire activity, and at investigating adaptation strategies and options to deal with future fire occurrence. There is growing consensus that as wildfire activity increases, fire agency suppression efforts will be increasingly strained. However, analyses of fire history suggest that it is the effect of climate variability on precipitation regimes that is the primary reason for the decreasing fire activity in the southern BDO Zone of Canada.

Risk Information: According to the National Interagency Fire Center, information about crop fires, including wildfires and controlled burns, show that in the past 3 years in Iowa there was a total of 546 acres affected in the entire State. The information available for Minnesota show that between Aug 2021 and Dec 2022 there was a total of 881 acres affected by fires in the counties of the supply zone. Crop fires are not an issue as the material is green. However, bale stacks could catch fire as a result of a lightning strike or human faults. The farm risk is very low due to the manageable number of stacks. The bigger risk is with the project storage yards that hold as much as 20% of their annual inventory. Spontaneous combustion due to wet material has never been reported. Given the information on crop fires, this is a negligible risk in the supply zone.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.7.4 Risk of Infestation

Rationale: Risk of future infestation, including its estimated consequences on feedstock supply, should be calculated into the overall risk profile.

Since forest insect populations are influenced by environmental conditions, future changes in climate can be expected to significantly alter the outbreak dynamics of certain forest insect species. In some cases, larger and more frequent insect outbreaks may occur, but in other cases recurring outbreaks may be disrupted or diminished. As climate continues to change, we can expect more situations, particularly at the margins of tree ranges, where sub-optimal conditions for tree growth and reduced tree vigor can lead to outbreaks of forest insects.

Risk Information: Corn diseases are air born. When equipment is moved from farm to farm, the bale chamber is cleared and the equipment is pressure blown to eliminate any material leaving the farm. This is part of the mechanics' role.

Farmers scout their crops for the arrival of pests during the growing season and will treat as preventative measures. A third-party baler could create a slight risk due to potentially inadequate sanitization of equipment, which could facilitate the transmission of diseases between fields. It is important to emphasize that most diseases can be effectively controlled with proper management practices, already widely in place.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**2**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**2**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**4**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**4**

3.7.5 Risk of Hail

Rationale: Hail has negligible impact of forestry biomass but is one of the principal destroyers of agricultural crops in North America.

There is much uncertainty about the effects of anthropogenic climate change on the frequency and severity of extreme weather events like hailstorms and their subsequent economic losses. Some studies indicate a strong positive relationship between hailstorm activity and hailstorm damage, as predicted by minimum temperatures using simple correlations. This relationship suggests that hailstorm damage may increase in the future if global warming leads to further temperature increase. Having a harvest logistics plan for the baling crews and avoid damaged fields where farmers communicate with the logistics control center to identify which fields will be harvested is a good practice.

Risk Information: The younger the corn is in its growth stage, the more susceptible it is to damage from stressors, including hail. However, once corn enters the dough stage, it becomes more resilient, and kernel loss due to stressors is no longer a concern.

Damage from hail in the supply zone is covered by crop insurance as the corn grain yield is affected. It is unlikely that a field hit by hail would be selected for stover harvest. This is part of the project logistics info prior to mapping the fields where the harvest will occur. The damaged areas are likely less than 1% of the total BDO zone.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.7.6 Risk of Flood

Rationale: Floods can cause catastrophic disruption and delay in feedstock supply. Where there is high risk of flood and thus negative impact to feedstock supply, the BDO Zone rating should account for this risk.

Risk Information: Whether a seed or seedling survives flooding is based on the length of time that flooding lasts and the soil temperature, corn can usually survive two to four days, sometimes more than a week if temperatures are cool and leaves are exposed. Crop lands are well drained with surface ditches and field tiles. As stated elsewhere, the harvested acres represent 96% of planted acres, additionally our outreach has found that it's been more than 20 years since floods created a supply problem within the supply zone.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.7.7 Risk of Drought

Rationale: Droughts can cause significant disruptions to feedstock supplies across entire BDO Zones for extended periods of time, especially in case of agricultural residues and energy crops. Parts of Western Canada are experiencing more frequent and severe droughts, and scientists expect drought to affect new areas across Canada going forward.

Tree species are adapted to specific moisture conditions. Having less water available through drought has a range of negative impacts on the health of forest ecosystems. Direct impacts include reduced growth, increased tree mortality and failure to regenerate. Indirect impacts include reduced ability to defend against insects and disease, and increased fire risk. These impacts can affect the availability of wood fiber for an Issuer.

Risk Information: According to the Department of Natural Resources in Minnesota, some degree of drought occurs in nearly every year in Minnesota. The historic 10-year yield in the region is 187 bu/acre, and during the 2021 drought, yields were 193 bu/acre. The average planted to harvest area in the supply zone in the past 10 years has been 96%. As evidenced by the data above, droughts are common but do not pose a significant risk to supply of feedstock.
Raw Risk Likelihood (RRL) **Score** The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10. **4**
Raw Risk Impact (RRI) **Score** The risk impact is deemed *low*, therefore the RRI is 4 out of 10. **4**
Gross Risk Indicator (GRI) **Score** The Gross Risk Indicator (RRL × RRI) is 16 out of 100. **16**
Mitigation/Notching **Notch** *RRL Mitigation (Notch)* **NN** No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).
Loaded RI Score **Score** The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100. **16**

3.7.8 Risk of Hurricanes, Tornadoes and Strong Winds

Rationale: Hurricanes, tornadoes, and strong winds can destroy timber stands, crops, and feedstock piles. They can also delay forestry and agricultural operations. Hurricanes and tornadoes can indirectly cause temporary shortages of available transportation as available trucking moves to handle higher value disaster related contracts. For example, Katrina cleanup limited availability of live-bottom trailers in the North and South-East of the US for several months as truckers shifted operations to handle more lucrative government contracts. Although scientists are uncertain whether climate change will lead to an increase in the number of hurricanes, warmer ocean temperatures and higher sea levels are expected to intensify their impacts. Recent analyses conclude that the strongest hurricanes occurring in some BDO Zones including the North Atlantic have increased in intensity over the past two to three decades.
Risk Information: Although tornadoes are somewhat common in the supply zone, outreach has found that it is not a risk to corn production. During the winter months (December through February) tornado activity is concentrated in the southeast U.S. Nearly three-quarters of all tornadoes in Minnesota have occurred during the three months of May (15%), June (37%), and July (25%).
Raw Risk Likelihood (RRL) **Score** The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10. **4**
Raw Risk Impact (RRI) **Score** The risk impact is deemed *low*, therefore the RRI is 4 out of 10. **4**
Gross Risk Indicator (GRI) **Score** The Gross Risk Indicator (RRL × RRI) is 16 out of 100. **16**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.7.9 Risk of Low Temperatures

Rationale: Low temperatures can cause crop failure, leading to shortages of biomass. Additionally, low temperatures can have adverse impacts on the operations of feedstock processing equipment in Northern BDO Zones.

Risk Information: Even though cold weather would not affect corn stover collection, it could potentially drive grain farmers to till early in order to avoid the soil to freeze, which would prevent collection in that season.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 24 out of 100.	**24**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No mitigation measures and notching would be required for low-risk indicators. *RRI Mitigation (Notch)* It is unlikely that grain farmers would risk next year's yields by postponing their tilling while corn stover is being harvested, therefore, this category has no notching. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100.	**24**

3.8 Risk Factor: Political and Social

3.8.1 Government Subsidies for Feedstock Production or Utilization

Rationale: Feedstock that is directly subsidized though government programs can pose greater long-term risk than feedstock that is not. Subsidies may be subject to amendment or repeal, sometimes with minimal notice.

NOTE: This risk indicator refers to direct feedstock subsides only; it does not apply to government subsidies that pertain indirectly to the operations of the Issuer such as Loan Guarantees or to the markets for products produced by the Issuer.

Risk Information: At this point there are no direct government subsidies for corn stover, however, corn is one of the biggest recipients of government subsidies in the US and its production directly affects the availability of corn stover.

The Agriculture Risk (ARC) and Price Loss Coverage (PLC) programs provide financial protections to farmers from substantial drops in crop prices or revenues based on a benchmark pricing of $3.70/bu. Although corn is directly subsidized, these programs have been in place for several decades and are not at risk of being repealed.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 2 out of 10.	**Score** **2**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 2 out of 10.	**Score** **2**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**Score** **4**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**Score** **4**

3.8.2 Local, Provincial, & National Laws, Regulations, & Permitting Pertaining to Biomass

Rationale: Feedstock whose production is directly dependent on local, provincial, or national laws or government regulations can pose greater long-term risk than feedstock that is not, since laws and regulations may be subject to amendment or repeal.

If utilization of biomass requires specific permits (i.e., percentage removal of forest residues or corn stover, allowable cut limits, air emission, storage permits, rights-of-way, overweight permits for trucks, cross-border permitting for shipment of biomass, chain of custody, or certification of sustainability) then likelihood of obtaining such permits and/or complying with permitting requirements should be examined.

Risk Information: Currently there are no regulations regarding corn stover production and use.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**Score** **2**
Raw Risk Impact (RRI) The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**Score** **2**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**Score** **4**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **N.A.**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is 4 out of 100	**Score** **4**

3.8.3 Backlash Against Biomass Development, Procurement or Usage in the Region

Rationale: Public backlash against biomass development in the Issuer BDO Zone can directly impact Issuer's ability to procure, transport, trans-load, store, or utilize feedstock by affecting local policies, regulations, and Issuer's ability to obtain necessary permitting.

Risk Information: Minnesota is actively promoting the development of bioenergy projects in several fronts such as the signing of the recent Bill Moving Minnesota to 100 Percent Clean Energy by 2040, which, among other things, encourages utilities to locate new energy generating facilities in communities where fossil-fuel-generating plants have been retired. Other private sector initiatives such as the first coalition to scale sustainable aviation fuel incentivize the production and use of SAF in the State. There is also the Natural Gas Innovation Act that creates incentives for gas companies to decarbonize their supply chains by introducing renewable natural gas, develop hydrogen-based fuels from renewables, fund energy efficiency projects, and encourage district energy, carbon capture, and geothermal heating. Support for all kinds of renewable alternatives is strong in the supply zone. Because of Minnesota's strong agricultural and food industries, biomass and other organics are an integral part of the deployment of such projects.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 2 out of 10.	**2**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 2 out of 10.	**2**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**4**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**4**

3.8.4 Consent of, and Co-operation with, Indigenous Communities and First Nations

Rationale: Where new project development on or near Indigenous or First Nation land, or where near Indigenous or First Nations exert influence over feedstock producing areas, consent of, and co-operation with, Indigenous communities and First Nations decreases Issuer risk.

Risk Information: There is no risk associated with Indigenous or First Nation land for this BDO Zone.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**NR**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**NR**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is not rated.	**NR**
Mitigation/Notching	**Notch**
The Total Notch (RRL Notch × RRI Notch) is not rated.	**NR**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is not rated.	**NR**

3.8.5 Food Security Concerns

Rationale: Despite the fact that any significant correlation between food prices and biofuel production is unclear, claims that biofuel production has driven up food prices, taken food from communities or had a negative impact on land use can fuel public backlash. For example, removal of biomass may raise public concerns relating to food security if Issuer feedstock requires the use of land that would otherwise be used for growing food.

Risk Information: Since corn stover is a by-product of corn grain production, there is no competition between renewable fuels and food. Additionally, corn stover is not a suitable animal feed alternative, being seldom used when as a last resort in the absence of any other alternative.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**Score** **2**
Raw Risk Impact (RRI) The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**Score** **2**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**Score** **4**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**Score** **4**

3.9 Risk Factor: Sustainability and Environmental Concern

3.9.1 Feedstock Sustainability

Rationale: Public concerns about sustainability of feedstock production can jeopardize biomass feedstock operations. Sustainability certification schemes should be utilized where applicable to ensure that feedstock comes from sustainable sources.

Canada leads all countries with 166 million hectares of certified forests, a figure that is nearly four times more than second place United States at 47 million hectares.

Risk Information: There is no established sustainability measure or large-scale life cycle analysis done for the collection and bailing of corn stover, therefore it is unclear how the sustainability certification would impact this operation. The primary concern regarding the feedstock sustainability for this project is the impact of organic matter in the soil due to the removal of corn stover. As discussed in Appendix A, we assume 60% of biomass being left in the soil for health purposes.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.9.2 Risk to Soil Quality

Rationale: Soil sustainability can be defined as management of soil in a way that does not exert any negative or irreparable effects either on the soil itself or any other systems. There is a diversity of approaches to soil sustainability in jurisdictional guidelines for forest biomass harvesting and production. For different feedstock types, there are also different thresholds at which feedstock removal causes significant negative consequences on soil.

Poor soil quality that negatively impacts the long-term sustainability of the feedstock can entail long-term feedstock risk. Sub-optimal soil management can leave exposed soil post residue-harvest which can lead to soil wash-off and soil carbon loss from precipitation and wind. Over-harvesting of biomass also depletes the carbon stock in the soil and creates a negative feedback loop which can degrade the soil and its nutrients.

Risk Information: Minnesota's most valuable and productive farmland lies across the southern quarter of the state, which is mostly an area of dark, fertile prairie soils and hot, humid summer weather, where corn and soybeans are the major cash crops. The soil organic matter (carbon) ranges from 4 to 8% in most black soils. Each percentage of organic matter enhances the available water capacity by over 3,000 gallons per acre and important to support crop growth during drought periods.[21] Sustainability of crop residue removal depends on factors like water availability, soil type, and management practices. For corn stover the two main challenges are the retention of enough nutrients on the ground and the protection from erosion.

The University of Iowa's Extension Program recommends that no more than 40% of the biomass left in the field for yields above 150bu/acre be removed. At these levels, there is sufficient biomass left on the surface to decompose and create new soil to replace soil loss through erosion, and replenish the organic matter. When corn grain yields have been greater than 175 bu/acre, growers complain about too much surface residue that prevents the soil from warming up the following spring, thus delaying the next crop. Research has shown a clear benefit of yield boost for the next crop of corn and soybeans, plus growers avoid costly fall tillage ($40/acre) to work part of the above ground stover in the soil.[22]

The timing of corn stover harvest in the fall creates a risk of soil compaction, which could lead to yield loss for the following crop. From 2018 onwards, manufacturers have improved their equipment to avoid and mitigate soil compaction. For example, large square balers now have four large tires with flex axles instead of two and stackers are better equipped with suspension, large tires and flex axles, all working to mitigate soil compaction. With the crop rotation changing to more soybeans, the soil potash levels are being depleted in some regions. As the soil in the area is a thick black soil with very minute levels of clay, compaction is an unlikely issue. Growers may want to adjust their farm gate price for stover to receive some compensation for nutrients removed, plus a profit.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**

[21] (https://blog-crop-news.extension.umn.edu/2020/03/the-connection-between-soil-organic.html
[22] https://ofa.on.ca/wp-content/uploads/2017/11/Determining-Optimal-Removal-Rate-Regional-Supply-of-Corn-Stover-in-Ontario.pdf

Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.9.3 Risk to Surface and Groundwater

Rationale: Excessive nutrient runoff from biomass feedstock production can accumulate in surface waters and result in algal blooms and hypoxia which can lead to habitat loss for aquatic species higher up the food chain and alter aquatic ecosystem food webs. Damage to aquatic ecosystems can cause social and regulatory backlash. Water intake issues can also increase risk.

Risk Information: Agricultural producers are regulated by the state for nutrient management and pesticide use, the two main sources of pollutants that can harm water bodies. Corn production relies heavily on fertilizers (N, P, K). While potassium is stable in the soil, nitrogen and phosphorus can move into the environment through leaching and surface runoff. A phosphorus index is used to limit over-application. Chemical applications to crops to fight pests and plant disease is part of routine best practices but some residues will find their way to surface water. Corn stover harvesting, as a byproduct of grain production, does not add to this risk.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**NR**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**NR**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is not rated.	**NR**
Mitigation/Notching	**Notch**
The Total Notch (RRL Notch × RRI Notch) is not rated.	**NR**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is not rated.	**NR**

3.9.4 Water Use

Rationale: Biomass feedstock operations can have significant impacts on the hydrological flux (infiltration, groundwater recharge, interception, and transpiration) of ecosystems. This can lead to water shortages, lower yields, and backlash from regulatory bodies if management plans are not properly instituted.

Risk Information: The stover harvest does not require water and the harvest season occurs when all crops have stopped growing in late fall, a time of year where evapotranspiration is not a factor.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**NR**

Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**NR**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is not rated.	**NR**
Mitigation/Notching	**Notch**
The Total Notch (RRL Notch × RRI Notch) is not rated.	**NR**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is NR out of 100	**NR**

3.9.5 Pesticide Risk to Human and Ecosystem Health

Rationale: Application of pesticides (i.e., herbicides, fungicides, and insecticides) on agricultural and forest landscapes can result in adverse health effects for humans and ecosystems. If pesticide application is required in feedstock production, the impact must be considered in the BDO Zone rating.

Risk Information: The R9 District is an intensive agricultural productive area focused on both corn and soybean production. The intensive nature of the farming activities puts pressure on the water and ecosystem health. On a county basis, 74 to 95% of the nine counties are covered by cropland. Ecosystem concerns are balanced through the provision of ecological programs to support balance. Farmers avail themselves of financing to set aside land through the Conservation Reserve Program.[23] Through partnerships with the Department of Natural Resources, it is addressing the preservation and restoration of grasslands to protect corridors for migratory birds using the Minnesota River corridor. Farmers contribute to ecosystem health using various tools implemented on farms to protect their soils and enhance their crops. These tools such as no fall tillage, use of cover crops providing green fodder through the non-growing season are important to support wildlife. Cover crops protect against wind and water erosion.[24] As a by-product of grain production, sustainable corn stover removal practices do not add risks to human or environment.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

[23] (https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/index) .
[24] (https://www.mprnews.org/story/2019/04/11/ag-census-2017-minnsota-snapshot)

3.9.6 Risk to Wildlife and Landscape

Rationale: Biomass production and supply chain operations with negative impacts on wildlife and landscape are at a greater long-term risk of encountering project setbacks and disruptions.

Risk Information: Through the USDA Conservation Services, farmers "set aside" least productive acres suitable for wildlife. The corn acreage is generally less than 30% of the total land available in the BDO zone. Additionally, as a by-product, sustainable corn stover removal do not add pressure to wildlife or landscape.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

3.9.7 Biomass Classified as Genetically Modified Organism (GMO)

Rationale: There are various risks associated with GMOs such as migration or dispersion across the landscape, which can generate community backlash and create supply chain risk. GMOs can also be heavily regulated. If planning to grow or procure GMO feedstocks, especially purpose-grown energy crops, it is important to understand the risks.

Risk Information: This is not relevant to corn stover. When it comes to stover, there is no quality designation enabling differentiation of feedstock sources.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**Score** **NR**
Raw Risk Impact (RRI) The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**Score** **NR**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is not rated.	**Score** **NR**
Mitigation/Notching The Total Notch (RRL Notch × RRI Notch) is not rated.	**Notch** **NR**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is not rated.	**Score** **NR**

Category 4.0 Feedstock Scale-Up Risk

4.1 Risk Factor: Feedstock Scale-Up

4.1.1 Feedstock Quality at Production Scale

Rationale: When biomass feedstock is a secondary or non-core line of business, or when it is a by-product or a residual from a more valuable primary product, then suppliers may not put in sufficient effort for consistent production. Risk of breach increases when production and/or delivery of feedstock compromises a supplier's ability to make a primary product.

When biomass feedstock is a by-product of another main higher margin or main product (e.g., corn stover (e.g., corn) or forest residues (e.g., pulpwood) supply may not be a top priority for a supplier.

Risk Information: Corn stover is an inevitable part of corn production and because it is a residue on the field, there is very little that can be done to improve its quality in that state. As a secondary crop, the biggest impact in quality would come from well managed collection operations, but because of the lack of demand and no history of commercial scale corn stover harvest, the likelihood of suppliers having experience in quality feedstock is low, therefore, the impact of the low quality of corn stover on biomass project could be significant.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 8 out of 10.	**8**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**64**
Mitigation/Notching *RRL Mitigation (Notch)* With the establishment of markets for corn stover, we expect the biomass project will work develop a protocol to harvest and collect corn stover to minimize soil contamination introduction to the bales. Thus, we notch the likelihood to 50%. *RRI Mitigation (Notch)* An experienced third-party bailing company can significantly offset the quality issues of feedstock. Therefore, this category is notched at 50%. The Total Notch (RRL Notch × RRI Notch) is 75%.	**Notch** **75%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

4.1.2 Capacity of Supply Chain Components & Equipment to Scale

Rationale: Scale-up risk increases if supply chain components, or underlying feedstock infrastructure necessary for these components, cannot scale to handle issuer feedstock requirements and throughput capacity. Capacity to scale should be demonstrated.

Risk Information: The infrastructure assets in place for the production of corn are widespread and optimized for the highest efficiency possible year-over-year, which leads to large quantities of available corn stover. However, the infrastructure required to handle corn stover collection, bailing and transportation does not exist due to the lack of commercial scale demand for this feedstock within the supply zone. Scale up would require a reputable project to incentivize distributors to participate in the supply chain and invest in their fleets, however, the speed of scaling up

infrastructure could negatively affect the quality and quantity delivered to a bio-based facility in the early stages of a project.	
Raw Risk Likelihood (RRL) The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**Score** **8**
Raw Risk Impact (RRI) The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**Score** **8**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**Score** **64**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* Introducing a third party that owns equipment can significantly reduce the scaling up risk, therefore this category is notched at 50%. The Total Notch (RRL Notch × RRI Notch) is 50%.	**Notch** **50%**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 32 out of 100.	**Score** **32**

CATEGORY 5.0: INFRASTRUCTURE RISKS

5.1 Risk Factor: Physical Infrastructure

5.1.1 Land Parcel

Risk Information: Region Nine (which consists of 9 counties in Southern Minnesota), has a population of roughly 232,000. New Ulm and Mankato both stand out as commercial centers for development and have been chosen as the industrial sites with the most promise for bio-based project development.

This report scores infrastructure risk based on the New Ulm Industrial lot. As agreed with the client, limited information will be provided for the Mankato Northport Industrial Park, as means of comparison only. Note that there are other sites that could be considered and developers are encouraged to speak with local economic development staff.

New Ulm's strategic positioning offers easy access to major highways, notably State Highway 15 and U.S. Highway 14 is roughly 29 miles away from the center point St. James. With competitive land pricing, New Ulm is particularly attractive for businesses and the New Ulm Industrial Lot near the airport, within the municipal limits, with 4.23 acres of heavy industrial designated land has been chosen as the primary industrial site for infrastructure risk scoring.

Additionally, Mankato has the Northport Industrial Park (38 miles from St. James) with qualified I-2 and I-1 zoned industrial lots available for development, located adjacent to Highway 14 and County State Highway 41.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

5.1.2 City Ownership

Risk Information: The New Ulm Industrial lot is privately owned and is available for immediate commercial development. Adjacent lands feature a mix of public and private ownership. Public sales and transfer of ownerships/titles are taking roughly 45-60 days. Major manufacturing and production facilities are located near/within the Airport Industrial Park. The Northport Industrial Park is owned and operated by the North Mankato Port Authority Commission, with nearby land consisting mainly of privately owned land.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

5.1.3 Industrial Land Use Zone

Risk Information: New Ulm and Northport Industrial Park both provide a mix of I-1 and I-2 zoned packages, catering to light and heavy industrial development needs. These zoning classifications ensure that businesses have diverse options for their specific industrial needs, including project size and operational requirements.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

5.1.4 Natural Gas Line

Risk Information: In Region Nine, natural gas services are primarily facilitated by local utilities that have developed pipelines for efficient delivery throughout the region. There are a number of competitors that operate within the state, allowing businesses to benefit from market-driven pricing. Notably, the company Oneok (refined natural gas & crude oil) has recently acquired from Magellan Midstream Partners new transportation (pipeline) segments that run directly through the Region Nine zone. Within New Ulm, the New Ulm Public Utilities Commission acts as the major distributor of commercial and residential natural gas. There are no notable capacity issues for the region, and commercial operations are able to reach long term bilateral agreements with providers on pricing. Currently for larger industrial packages that include usage of over 50,000 CCF (100 cubic feet) per year, commercials can expect on average $0.6657 per CCF in New Ulm and North Mankato industrial sites.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

5.1.5 Electrical

Risk Information: Within Region Nine, electricity and power generation infrastructure are primarily overseen by Southern Minnesota Municipal Power Agency. Within New Ulm itself, commercial electrical power is consistent and reliable, supplied by Xcel Energy, Great River Energy (GRE), and Alliant Energy. Major electric transmission systems within the region are maintained by Xcel Energy, Dairyland Power Cooperative, ITC Midwest and GRE. Most commercial operations with needs of 500 therms or less per day at peak can roughly estimate costs of $0.6582 per KWH in New Ulm/Mankato regions, with both single phase and three phase services available. This is available to commercial clients with requirements of 210,000 KWh per month or more.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.1.6 Fresh Water Supply

Risk Information: Within Region Nine, the primary source of water is derived from wells. The New Ulm specific pumping capacity is 3,500 gallons per minute, which can effectively cater to the daily average residential and commercial water demand. Industries operating in Region Nine benefit from a competitive industrial water rate of roughly $2.89 per million gallons.

Northport businesses operating as heavy manufacturing, processing or like purpose facilities with annual average monthly consumption of at least 840,000 gallons will qualify for industrial level packages which provide either single or multiple meters at rough estimates of $3.08 per gallon.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.1.7 Sewage Disposal Trunk Line

Risk Information: The New Ulm Industrial lot (located within municipal city limits) has access to the municipal public sewage disposal, where the treatment is managed through the local mechanical plant. The New Ulm Wastewater

Treatment Plant treats an average of 2.25 million gallons per day. This plant has a capacity of 6 million gallons per day, with an average flow of 2.5 million gallons daily. During peak times, the flow can reach up to 4.5 million gallons per day. Commercial entities in New Ulm are charged at a rate of $3.94 per gallon.

Northport industrial park currently charges a commercial rate of $4.22 per gallon, with peak time services offered at premium if operational needs are deemed higher than average.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.1.8 Drainage and Stormwater Management

Risk Information: New Ulm manages drainage and stormwater under the Municipal Storm Sewer System, which includes the industrial park, likewise for Northport Industrial Park large commercials are required to adhere local guidelines. The site's storm drains funnel rainwater and local pollutants like oil to nearby water bodies, which the municipality of Mankato has made special pollution prevention campaigns to avoid the dumping of hazardous materials like fertilizers and pet wastes in storm drains.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.1.9 Available ICT (Information & Communication Technology) Services

Risk Information: New Ulm and Northport industrial parks offer major telecommunications infrastructure, supported by local telephone providers and various cell phone services. The city features comprehensive connectivity, including DSL/ISDN/T1/Fiber Optics, Wired Buildings/Wi-Fi/Networking. Residents and businesses have access to multiple television and broadband providers such as T-Mobile Home Internet, Xfinity, CenturyLink, Comcast Business, HughesNet, Viasat, Nuvera, DISH Network, and DirectTV. Public high-speed broadband internet sites are also available.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**2**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**2**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**4**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**4**

5.1.10 Infrastructure – Landfill/Alternative Markets for Waste Disposal

Risk Information: New Ulm has a waste collection facility nearby to meet the disposal needs of its residents and commercials, with some additional fees. The Brown County Landfill has a fee set at $55/ton, with an added 17% Solid Waste Tax, bringing the total to $64.35 per ton. However, there is a minimum charge of $15 for services utilized at this landfill.

For Northport Industrial Park there is the Ponderosa Landfill located 8 miles southwest of Mankato. The landfill offers disposal services with cash prices at $0.03 per pound and a minimum rate of $5.13 per load, plus a 17% Minnesota State garbage tax. For commercial MSW loads, the charge is $45 per ton with the same minimum and tax rate.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**

Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

5.2 Risk Factor: Logistics

5.2.1 Road and Highway Access and Intersection

Risk Information: New Ulm is well-served by major transport highways like the U.S. highway 14 and State Highway 15. Additionally Interstate highway 169 and U.S highway 14 provides the major routes of transport for the Northport Industrial Park. These major routes enhance Region Nine's as a logistically attractive location for businesses seeking efficient transit solutions with close proximity to major Minnesotan hubs.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

5.2.2 Ocean/River Access

Risk Information: Region Nine offers unique waterway advantages for businesses. While inland, Region Nine provides businesses with efficient access to major transportation routes for both drayage and source loading, it does lack any viable rivers for barging in any consequential way. This said, Region Nine is within reach of significant Midwest ports, such as the Port of Duluth on Lake Superior (249 miles away), the Minneapolis Container depot (96 miles away), and the New Richmond Terminal in Wisconsin (136 miles away). These key distribution hubs serve as a crucial gateway for international trade, and Region Nine is well situated to take advantage of multiple lanes of transport for both a domestic and global marketplace.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment.	**NN**

RRI Mitigation (Notch) No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).
Loaded RI Score **Score** The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100. **16**

5.2.3 Railway Service

Risk Information: The CP main line runs directly adjacent to New Ulm and Mankato (already servicing major companies such as ADM, Ardent Mills and Louis Dreyfus). The railway borders the South side of the industrial parcel and would require investment in a spur for goods to be loaded into the cars. New Ulm is linked to the Minnesota Prairie Line, which further connects with major Class I railroads, including Canadian Pacific and BNSF, running throughout the state.
Raw Risk Likelihood (RRL) **Score** The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10. **6**
Raw Risk Impact (RRI) **Score** The risk impact is deemed *medium*, therefore the RRI is 6 out of 10. **6**
Gross Risk Indicator (GRI) **Score** The Gross Risk Indicator (RRL × RRI) is 36 out of 100. **36**
Mitigation/Notching **Notch** *RRL Mitigation (Notch)* **NN** CAPEX and permitting details could provide more clarity for a developer interested in accessing rail. However, that is a negotiation between the rail operator, the town and the project, and therefore, this category cannot be mitigated. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).
Loaded RI Score **Score** The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100. **36**

5.2.4 Accessibility to Airport

Risk Information: The region hosts four general aviation airports: Brauns Airport in Sleepy Eye, New Ulm Municipal Airport (ULM), Sleepy Eye Municipal Airport, and Springfield Municipal Airport. These facilities cater to regional air travel and small aircraft operations. For broader commercial flight needs, the nearby Minneapolis-Saint Paul International Airport (90 miles away) provides extensive domestic and international connections, providing New Ulm with appropriate connectivity for businesses and residents in the region.
Raw Risk Likelihood (RRL) **Score** The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10. **4**
Raw Risk Impact (RRI) **Score** The risk impact is deemed *low*, therefore the RRI is 4 out of 10. **4**
Gross Risk Indicator (GRI) **Score** The Gross Risk Indicator (RRL × RRI) is 16 out of 100. **16**

Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.3 Risk Factor: Social Infrastructure

5.3.1 Healthcare Facilities

Risk Information: The New Ulm Medical Center Clinic is a part of the New Ulm Medical Center, which is a nonprofit hospital and clinic that offers a wide range of care options, including inpatient, outpatient, emergency, and specialty with over 70 affiliated physicians and 25 beds. This facility also hosts primary care services. Overall, there are this facility is the main healthcare provider for the city.

In Mankato residents are serviced by the Mayo Clinic Health System-Mankato, a general medical and surgical facility with 142 beds and 11 ICU stations, and the Mankato Clinic, is a physician-owned, multi-specialty healthcare organization offering a wide range of services, including primary care, specialty care, and digital care options.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.3.2 Educational Facilities

Risk Information: The Martin Luther College is a private liberal arts college in New Ulm that offers undergraduate and graduate programs in education, ministry, and the liberal arts. The college has a student population of approximately 1,200. New Ulm Public Schools is the only school district in New Ulm, MN. It serves students from Pre-Kindergarten through 12th grade and has four schools: Washington Learning Center, Jefferson Elementary, Middle School, and High School. According to Great Schools,[25] New Ulm Public School District has a rating of 6/10 for its middle school and a

[25] https://www.greatschools.org/minnesota/new-ulm/

rating of 7/10 for its high school. The district's average testing ranking is 8/10, which is in the top 30% of public schools in Minnesota.

Minnesota State University, Mankato is the largest university in Mankato. Additionally, the South Central College in Mankato is a two-year community and technical college that offers a wide range of programs in business, health, human services, and technology. The college has a student population of approximately 2,500 and it has a division called Customized Workforce Education (CWE) that provides high-quality training to help organizations train and retain their workforce.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.3.3 Transportation Facilities

Risk Information: New Ulm is serviced by the Heartland Express which is an on-demand dial-a-ride service that supports local businesses by providing employees transportation to work. Additionally, the town is rolling out another fixed route bus system that will service residents on a pre-determined schedule.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.3.4 Recreational Facilities

Risk Information: New Ulm has varied recreational options with a location beside the Minnesota River, residents can partake in fishing and other water activities. With 34 city parks and the adjacent Flandreau State Park, there's ample green space available. The city also has the Hermann Monument and an extensively updated $14 million recreation center. There is also a newly renovated BMX and skate park, as well as a Civic Center that features two ice pads and has the capability to host events. Further northeast of New Ulm and Mankato are the twin cities (Minneapolis/St. Paul), which offer many entertainment options from the Minneapolis Symphony Orchestra to professional sports like the Minnesota Vikings in the NFL, and the Minnesota Wild in the NHL and the Timberwolves in the NBA.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**2**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**2**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**4**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**4**

5.3.5 Cultural Facilities

Risk Information: Cultural attraction is limited in New Ulm. The Grand Center for Arts and Culture is a non-profit organization that aims to enrich community life through arts and cultural education and experiences. They offer various spaces for arts education, live entertainment, a gallery space, and studio spaces for working artists. The Brown County Historical Society, centrally located in the city, showcases regional artifacts and historical exhibits.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

5.3.6 Public Safety Facilities

Risk Information: In New Ulm, fire protection services are provided by the New Ulm Fire Department, and law enforcement duties are managed by the New Ulm Police Department. The City County's Law Enforcement Center encompasses the Sheriff's Department and the Brown County Dispatch. The Fire Department has 41 volunteer firefighters and operates from two locations. Total violent crime rate in Minnesota is 280/100,000 residents, lower than the National average of 380/ 100,000.[26] New Ulm had a total of 23 crimes reported in 2022, of which virtually none were violent, which equates to around 163/100,000 residents.[27] Mankato had 116 reported crimes in 2022, which equates to around 260/100,000 residents.

Raw Risk Likelihood (RRL) The risk likelihood is deemed ***very low***, therefore the RRL is **2 out of 10.**	**Score** **2**
Raw Risk Impact (RRI) The risk impact is deemed ***very low***, therefore the RRI is **2 out of 10.**	**Score** **2**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**Score** **4**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**Score** **4**

5.3.7 Housing

Risk Information: The median gross rent in New Ulm stood at $774, notably lower than Southern Minnesota's median of $1,010. The vacancy rates for market rate units, affordable units, and subsidized units were 0.3%, 0.0%, and 1.8%, respectively. In the market rate units, the majority were two-bedroom at an average rent of $858, whereas affordable units were majorly one-bedroom with an average rent of $610. On the for-sale housing front, New Ulm experienced a shift in resale prices, with the median resale price surging to $196,900 in 2023, a 22% increase from 2022. This surge affected first-time homebuyers, as prices rose faster than wage growth. Inventory was low with only minor amounts of homes listed in 2023.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**Score** **8**
Raw Risk Impact (RRI) The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**Score** **6**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 48 out of 100.	**Score** **48**

[26] https://cde.ucr.cjis.gov/LATEST/webapp/#/pages/explorer/crime/crime-trend
[27] https://www.homesnacks.com/mn/new-ulm/

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 48 out of 100.	**48**

5.4 Risk Factor: Workforce and Permitting

5.4.1 Labor Availability

Risk Information: New Ulm's labor market is growing in line with national figures. Since 2022, employment in the region saw a growth of 1.24%, increasing from 13.3k to 13.5k full time employees. The most prevalent job categories in New Ulm include Production Occupations with 1,532 individuals, Management Occupations with 1,441, and Office & Administrative Support Occupations with 1,424. These figures depict the primary employment sectors of the city's residents, emphasizing variable labor availability in New Ulm. The region's broader labor market is marked by a mix of skilled professionals across various sectors, with a notable presence in manufacturing, healthcare, and education. Most individuals will drive within the region for workforce opportunities, with average commute distances of roughly 30-50 miles from their homes. Finally, the region has an unemployment rate of 3.20%, up from 2.40% in 2022, but still below the long-term average of 4.55% in the region which translates to a fairly tight labor market within City limits.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

5.4.2 Labor Cost

Risk Information: New Ulm's workforce divided into three age groups: 29 or younger (23.0%), 30 to 54 (48.3%), and 55 or older (28.7%). The median age is close to 40. The average income for the region is $52,000 per year, but it varies by age and skill level. The lowest income group (23.5%) earns $30,000 or less, the middle-income group (27.8%) earns between $30,001 and $49,999, and the highest income group (48.7%) earns $50,000 or more. Compared to the national averages, Minnesota has a slightly higher labor cost ($28.60 vs. $27.44 per hour).

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.4.3 Training Programs/Community College

Risk Information: South Central Technical College in North Mankato provides vocational and academic programs in agriculture, accounting and business, and Waseca University of Minnesota's Extension, supporting community development and engineering. The District 88 Career and Technical Education Center (CTE Center) is a new facility that provides high school students in New Ulm and surrounding areas with exposure and access to careers in various technical and skilled trades.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

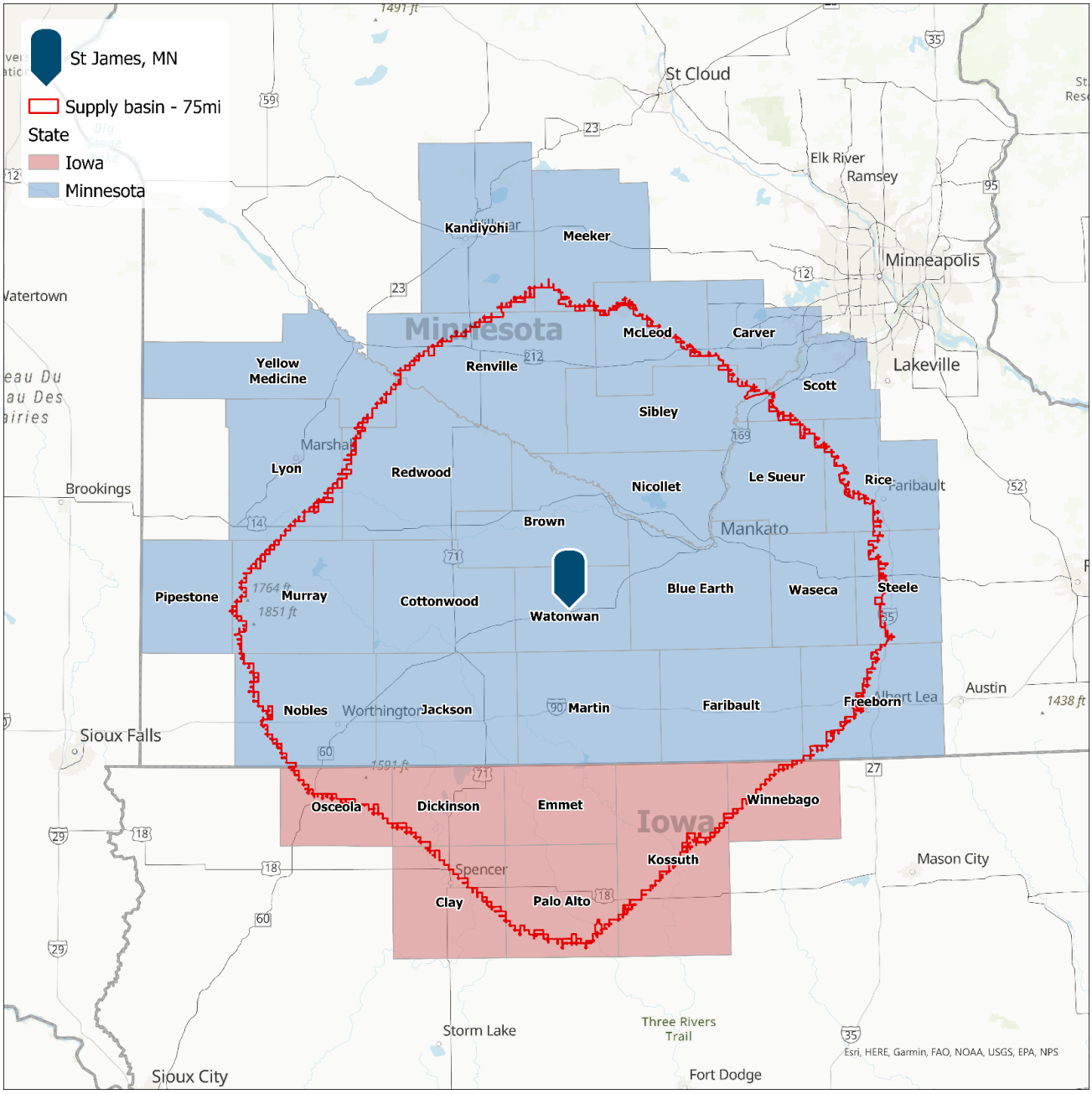
5.4.4 Permit Process

Risk Information: In New Ulm, the commercial development process begins with a submission to the city's planning department, typically undergoing a review period of several weeks. Site plan approvals and permit acquisitions span an estimated 3-5 months, followed by appropriate zoning hearings that will occur at the municipal level (spanning no longer than 30 days).

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

APPENDIX C: TABLES, FIGURES AND MAPS

Map C-1: Counties within the supply zone.



Map C-2: Ethanol plants within the supply zone

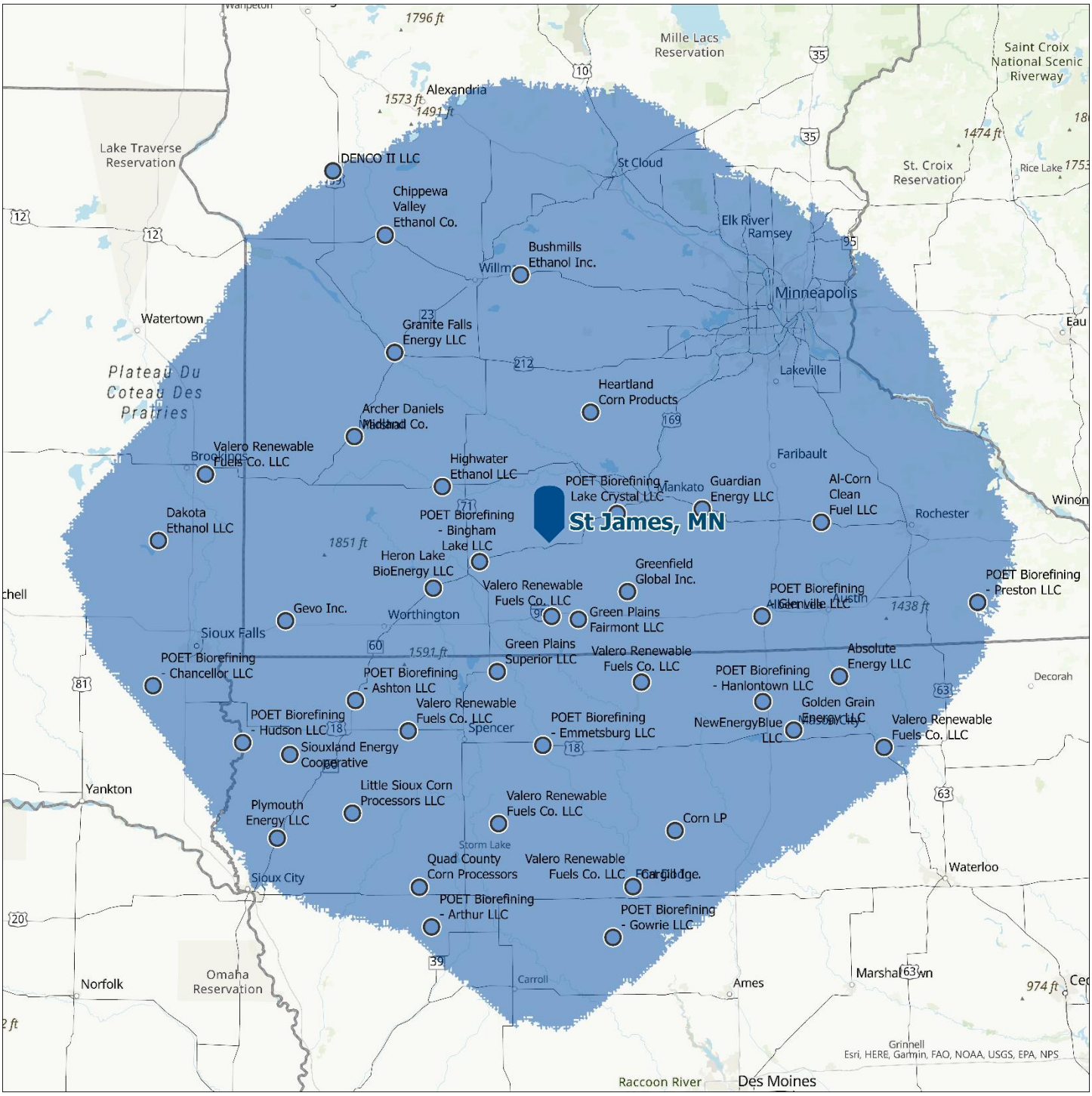


Table C-1: 10-year Corn harvested area in acres within the supply zone[28]

Harvested Area (acres - ovrl adjusted)										
County	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
BLUE EARTH	199,500	188,200	190,100	189,900	-	176,900	182,400	-	180,800	176,600
BROWN	164,200	158,700	150,800	154,200	-	139,700	133,600	155,300	145,500	151,800
CARVER	1,506	1,067	1,487	1,560	1,436	1,376	-	1,280	1,269	1,321
CLAY	30,759	31,843	30,146	29,880	30,350	29,021	27,937	27,834	28,203	28,244
COTTONWOOD	181,700	173,400	180,200	177,200	176,000	162,100	-	-	164,600	165,000
DICKINSON	85,739	85,094	84,541	82,052	82,789	80,023	84,541	87,491	82,881	85,002
EMMET	119,400	119,000	120,300	122,200	118,300	108,400	-	113,700	107,900	109,200
FARIBAULT	200,000	214,500	210,500	213,000	202,000	196,900	215,500	201,000	206,500	198,100
FREEBORN	57,332	81,705	76,138	81,903	72,361	-	-	73,634	73,832	71,964
JACKSON	200,000	185,000	184,300	189,400	182,500	184,500	169,800	190,400	186,700	186,400
KANDIYOHI	4,624	3,858	4,004	4,178	-	3,980	-	-	-	-
KOSSUTH	164,708	177,294	171,001	182,766	168,539	161,699	169,633	166,623	163,887	158,142
LE SUEUR	86,383	86,191	87,723	91,841	-	-	-	-	79,583	79,392
LYON	22,688	20,681	20,476	21,000	20,750	20,100	13,100	21,137	19,838	18,595
MARTIN	228,500	228,500	222,000	236,000	215,500	198,900	213,500	216,500	205,000	203,000
MCLEOD	73,006	46,970	64,888	65,757	60,771	-	64,714	-	65,641	62,742
MEEKER	8,850	7,093	7,477	7,915	6,874	-	7,511	-	7,942	7,272
MURRAY	165,319	156,347	161,499	146,486	153,682	148,352	107,400	157,591	159,190	150,573
NICOLLET	132,500	113,100	107,300	120,000	108,200	109,900	112,400	110,800	109,800	107,600
NOBLES	163,743	161,020	157,520	155,964	160,242	152,541	-	156,742	151,141	148,185
OSCEOLA	43,666	44,419	43,738	43,666	44,419	40,260	42,053	43,989	40,834	39,723
PALO ALTO	133,601	145,141	134,066	138,713	131,510	123,455	122,603	132,982	118,576	126,089
PIPESTONE	42	38	33	37	38	-	28	33	39	35
REDWOOD	243,374	227,921	221,161	224,541	219,229	-	207,157	-	227,921	227,921
RENVILLE	227,056	202,757	215,504	227,455	205,147	193,595	188,019	197,977	195,189	197,977
RICE	15,514	16,609	16,852	17,258	15,210	16,649	-	-	16,122	17,075
SCOTT	8,424	7,374	8,027	6,907	7,211	-	-	7,631	7,841	7,421
SIBLEY	170,577	135,105	143,343	151,193	134,329	138,400	143,731	-	145,281	144,118
STEELE	24,136	39,332	34,639	36,778	34,480	34,352	33,618	33,043	34,767	33,362
WASECA	105,800	113,500	109,400	117,600	104,100	113,600	113,200	114,300	108,600	111,800
WATONWAN	138,000	135,900	126,200	131,100	120,700	123,600	121,400	129,500	121,600	128,900
WINNEBAGO	24,415	29,734	27,619	30,602	27,286	26,262	26,974	26,751	25,639	25,305
YELLOW MEDICINE	10,876	9,867	9,515	10,203	9,825	10,066	-	10,503	-	9,504
Total harvested area	**3,435,936**	**3,347,260**	**3,322,498**	**3,409,256**	**2,813,777**	**2,694,633**	**2,500,816**	**2,376,740**	**3,182,616**	**3,178,360**

[28] https://quickstats.nass.usda.gov/

Chart C-1: Average corn grain production within the supply zone[29]

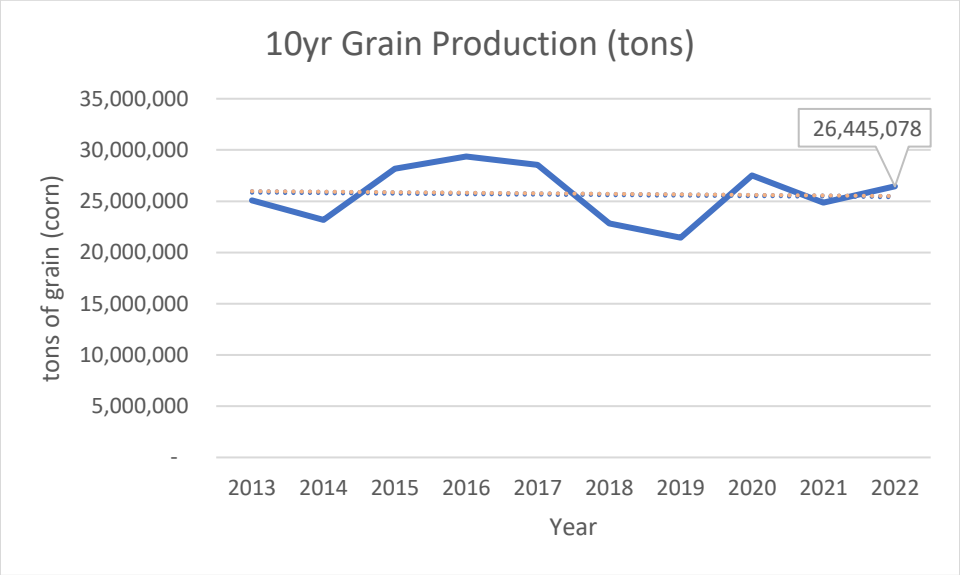
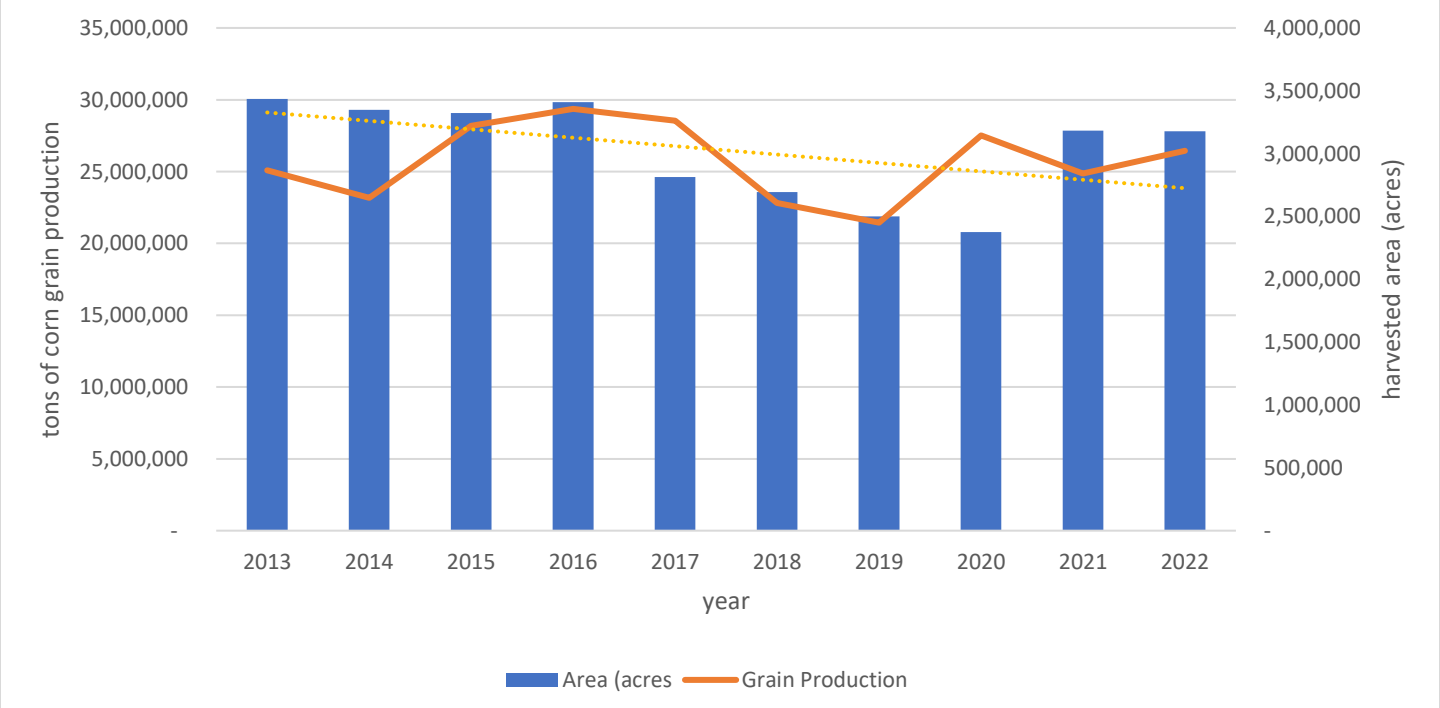


Chart C-2: Harvested area in acres and grain production in tons in the supply zone[30]



[29] https://quickstats.nass.usda.gov/
[30] https://quickstats.nass.usda.gov/

Table C-2: 10-year historical corn grain production in tons[31]

	Production (tons) - Adjusted for County Overlay									
County	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
BLUE EARTH	1,034,796	833,784	1,072,176	1,014,132	1,045,940	857,220	953,400	997,304	1,014,496	1,086,876
BROWN	785,120	747,320	797,944	825,384	797,216	623,476	662,816	885,780	762,664	886,620
CARVER	249,368	141,960	321,160	325,668	318,220	265,188	225,736	276,220	254,352	277,620
CLAY	1,267,840	1,122,408	1,346,520	1,513,456	1,471,204	1,330,896	1,412,432	1,131,284	1,459,836	740,488
COTTONWOOD	867,328	852,936	1,006,768	994,000	1,022,784	788,256	680,596	951,524	893,172	985,908
DICKINSON	422,800	408,072	499,408	468,440	493,360	389,760	436,520	484,148	447,300	525,084
EMMET	556,192	549,920	684,936	679,252	696,024	472,892	-	592,480	551,376	653,408
FARIBAULT	985,376	987,196	1,222,704	1,243,200	1,218,000	891,744	1,118,264	1,209,460	1,107,260	1,199,772
FREEBORN	637,028	962,640	1,081,920	1,117,536	1,077,888	902,300	1,002,764	1,047,480	1,076,320	1,089,620
JACKSON	981,036	868,616	1,036,896	1,029,476	1,049,860	862,764	742,000	1,045,436	991,144	1,113,252
KANDIYOHI	842,464	625,604	801,500	885,276	838,880	843,556	-	816,396	-	-
KOSSUTH	1,413,552	1,602,412	1,741,432	1,914,276	1,773,044	1,490,664	1,724,604	1,625,848	1,599,276	1,598,912
LE SUEUR	414,708	373,324	515,928	526,960	535,948	423,696	-	442,428	473,732	489,776
LYON	836,584	774,004	972,048	1,049,356	932,372	887,880	550,872	1,065,232	793,156	803,768
MARTIN	1,201,340	1,077,496	1,264,284	1,372,000	1,291,248	894,992	1,025,080	1,233,624	1,115,856	1,278,340
MCLEOD	568,148	291,760	601,440	594,692	605,080	574,028	585,928	584,920	612,360	586,236
MEEKER	577,024	435,708	586,488	612,780	542,052	-	522,116	597,324	520,940	555,968
MURRAY	918,372	781,984	1,015,308	925,512	954,604	791,784	506,576	965,636	985,964	910,756
NICOLLET	645,512	488,544	621,432	703,556	623,364	572,404	617,064	638,792	640,696	625,156
NOBLES	994,896	910,924	1,097,236	1,052,016	1,115,744	926,380	693,336	1,043,784	1,101,632	1,076,404
OSCEOLA	620,816	608,440	699,272	694,708	734,244	566,776	599,284	636,608	663,348	613,032
PALO ALTO	815,444	863,548	957,292	983,136	929,236	704,564	879,116	870,660	814,912	893,004
PIPESTONE	536,984	427,560	491,008	578,844	551,068	-	290,276	487,900	550,676	449,036
REDWOOD	1,174,824	1,095,528	1,266,888	1,320,368	1,276,968	1,078,196	1,088,472	1,363,908	1,136,576	1,252,888
RENVILLE	1,383,956	1,075,088	1,445,388	1,589,140	1,492,960	1,222,368	1,242,780	1,380,232	1,208,592	1,480,976
RICE	360,976	360,164	467,852	448,784	439,348	413,980	-	458,556	435,848	510,412
SCOTT	165,172	121,996	184,408	161,784	173,124	-	-	182,028	187,964	166,068
SIBLEY	792,680	529,536	769,804	879,676	800,324	712,460	777,420	807,716	851,200	859,376
STEELE	333,256	581,196	611,716	649,572	649,656	579,124	510,580	585,396	625,688	635,824
WASECA	508,480	509,124	610,316	673,736	626,584	627,508	579,348	654,164	645,876	673,344
WATONWAN	733,628	708,876	728,252	687,960	739,676	519,708	582,092	754,572	711,592	766,948
WINNEBAGO	457,884	645,904	707,476	761,964	723,240	597,436	674,716	697,004	637,392	692,748
YELLOW MEDICINE	995,260	807,744	949,900	1,087,688	1,005,256	1,005,788	759,192	996,296	-	967,456
Total grain (tons)	**25,078,846**	**23,171,318**	**28,177,103**	**29,364,331**	**28,544,519**	**22,817,790**	**21,443,382**	**27,510,142**	**24,871,198**	**26,445,078**

[31] https://quickstats.nass.usda.gov/

Chart C-3: 10-year historic corn prices[32]

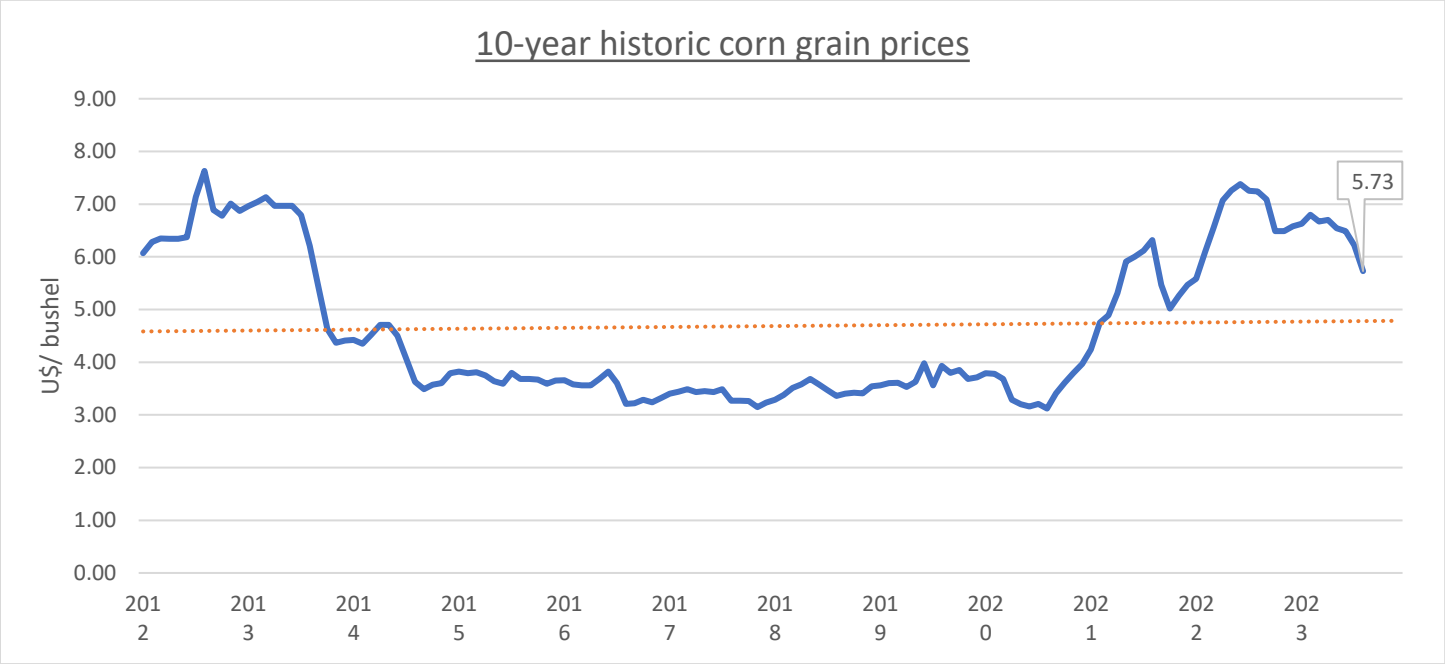
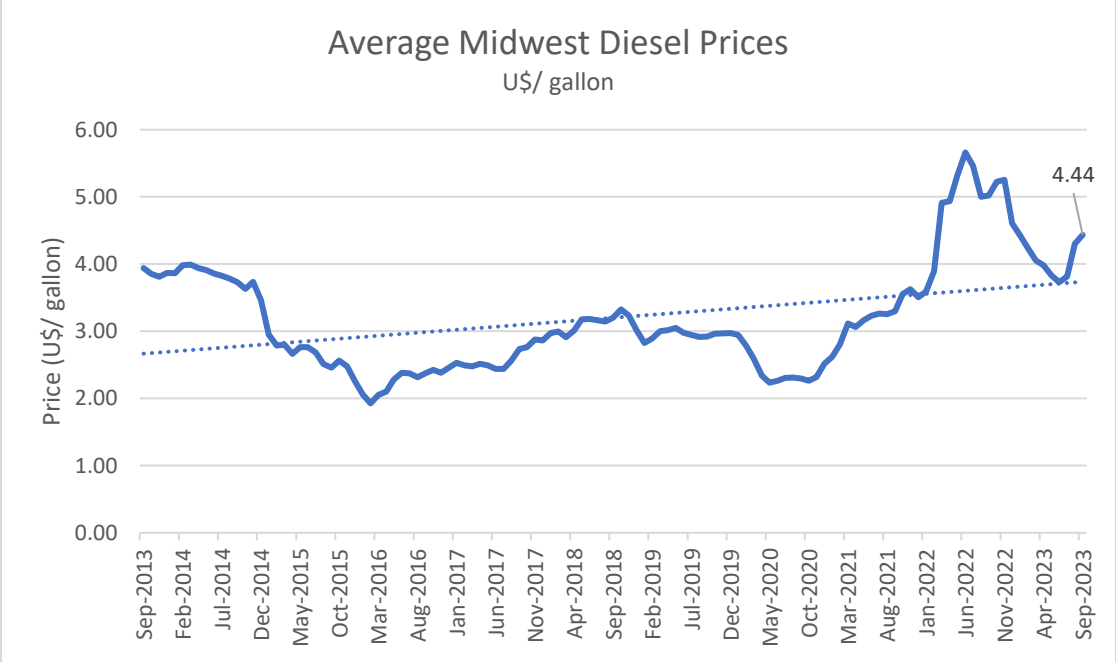


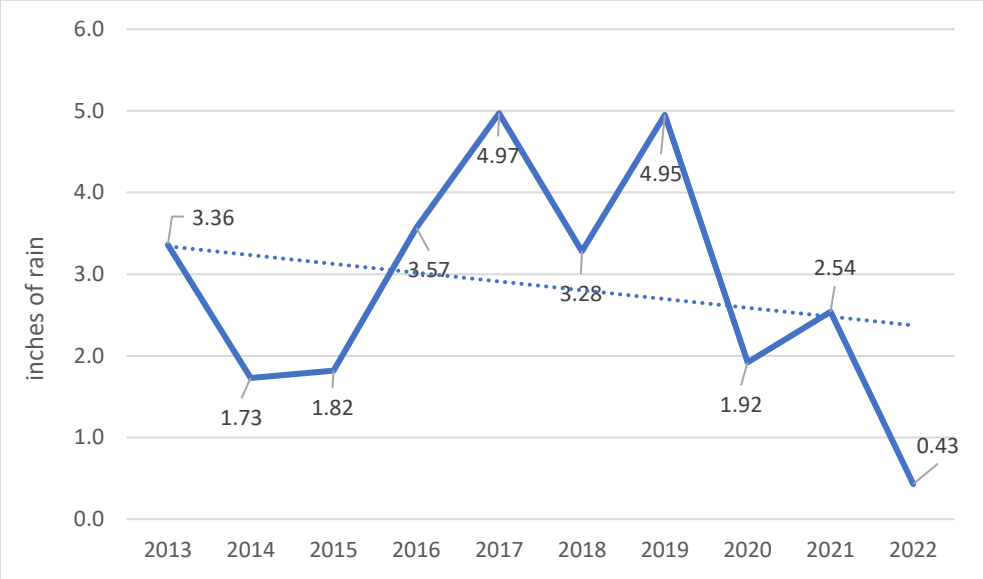
Chart C-4: 10-year average Midwest Diesel prices



Source: EIA

[32] https://quickstats.nass.usda.gov/

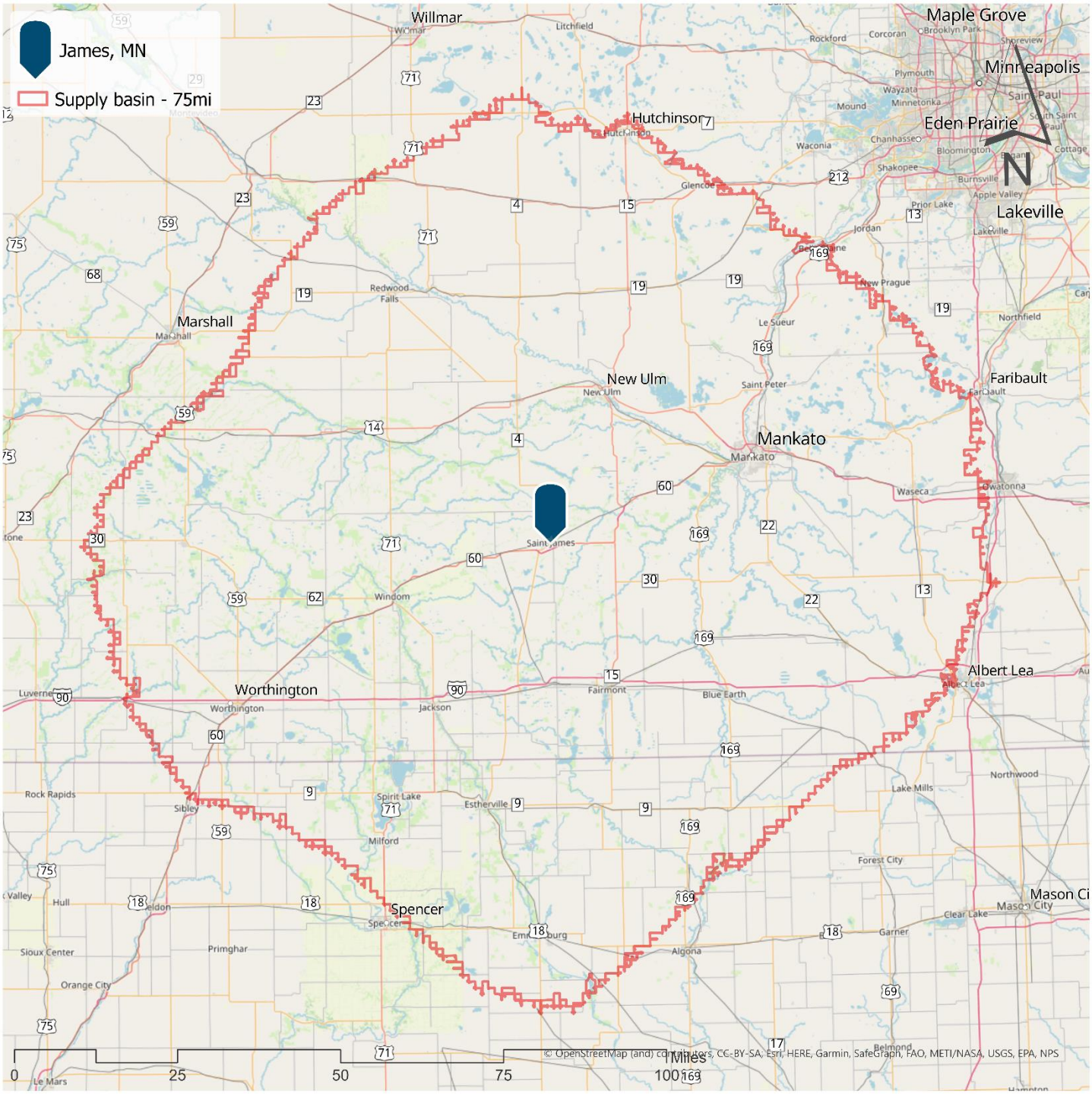
Chart C-5: 10-year precipitation in October (in inches of rain)



Source: Minnesota climate trends[33]

[33] https://arcgis.dnr.state.mn.us/ewr/climatetrends/

Map C-3: BDO Zone Road Network. This map overlays the Supply Zone (75mi drive distance) over the road network.



APPENDIX E: LEGAL DISCLAIMER

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