Biofuel Development Zone Risk Rating

A

The City of Melville, SK Biofuel Development Zone is rated "A". Long- term outlook on price and quantity for wheat straw is deemed stable. Key scale-up risks are likely addressable with reasonable mitigation measures.

Rating Parameters

Quantity	Feedstock Form	Price Range	BD Zone Radius
200,000-300,000 ODMT	**Square/round bales**	**$65.00-$90.00 delivered**	**90-110 km**

BD Zone Assets

- **Stable long-term outlook on feedstock price and quantity: low impact of seasonal variation on feedstock price and quantity.**
- **Large Biomass Availability Multiple (BAM) at a 38% grower participation rate and within 150 km.**
- **In the event of decreased wheat straw production, supply basin can be expanded at a marginally increased transportation cost.**
- **No large-scale competition for wheat straw.**
- **Postively rated infrastructure asset profile.**

BD Zone Liabilities

- **Lack of suitable harvesting equipment for large-scale harvest at the present time. Moderate to high probability of necessity to engage third-party company to provide square balers.**
- **Average farm size is relatively small. Thus, sourcing large quantities will require engagement of large numbers of growers.**
- **Lack of initial interest from large growers.**

BD Zone Risk Rating

The City of Melville, SK Biofuel Development Zone is rated "A", or *low risk*.

Risk Rating Grades are defined as follows: Aa (*very low*), A (*low*), Baa (*low-moderate*), Ba (*moderate*), B (*moderate-high*) or C (*high*).

In assessing the biomass supply chain risk for the City of Melville, SK Biofuel Development (BD) Zone, 53 Risk Indicators from the *Canadian Biomass Supply Chain Risk Standards* were applied.[1] These BD Zone Risk Indicators are the subset of BSCR Risk Indicators applicable to gauging feedstock risk within a BD Zone.

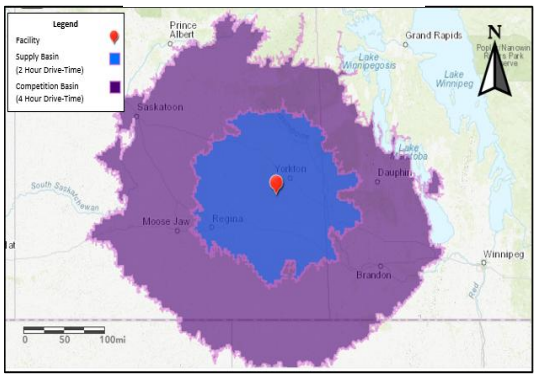
Feedstock Quantity is expressed in oven-dried metric tonnes (ODMT). Feedstock Price is expressed in Canadian dollars, FOB plant yard, assuming the plant is located centrally in the BD Zone. Maximum transport distance is calculated assuming the maximum quantity in this BD Zone Rating (300,000 ODMT). Delivered feedstock cost for projects with lower intake can be expected to be at the lower end of the BD Zone's price range.

Scoring and Ratings Methodology

The BD Zone rating is based on an aggregation of the scores assigned to each BD Zone Risk Indicator (RI) assessed in this report. First, each BD Zone Risk Indicator is given a **Raw RI** score based on the current, undeveloped state of the supply chain, and the uncertainty drivers within it. Raw RI Scores are scaled between 1 (*low risk*) and 10 (*high risk*).

Next, each Risk Indicator is discounted, or "notched", based on the degree to which the uncertainty drivers are deemed to be addressable, and whether there is a reasonable expectation that mitigation measures could be put into place within the price parameters for this rating. The **Notched Salience score** represents this, and corresponds to the likelihood of each Risk Indicator's described risk materializing given the implementation of reasonable mitigation measures. To arrive at the Notched Salience score, Raw RI scores

Melville, SK BD Zone



[1] Details on zone characteristics can be found in Appendix D.

are reduced based on the efficacy of the proposed mitigation measures. If applicable, notching occurs at one of four levels: *moderate* (25%), *significant* (50%), *broad* (75%), or *comprehensive* (100%).

Finally, the potential impact of each Risk Indicator on the supply chain is assessed and scored on a 10-point **Impact Level** scale, as either *low (3.33)*, *moderate (6.66)*, or *high (9.99).* Impact level scores are based on the assumption that key measures were implemented to mitigate uncertainty drivers in the BD Zone but failed to do so.

The **Loaded RI** score for each Risk Indicator is then calculated as the product of Notched Salience andImpact Level scores. For example, Risk Indicator 3.2.2: *Low Historical Demand for Feedstock in the Supply Basin*; Notched Salience is scored at 4.5 and Impact Level is deemed *low* (i.e., 3.33 out of 10). The final Loaded RI score for RI 3.2.2 is therefore 4.5 x 3.33 = 14.99 (out of 100).

Loaded RI scores of 33.33 or less are deemed *low risk*; scores greater than 33.33 and less than 66.66 are deemed *moderate risk*; and those that score 66.66 to 100 are deemed *high risk*.

The total risk rating for the BD Zone is the average of all Loaded RI scores. The BD Zone score for The City of Melville, SK is ***15.41 out of 100, resulting in an "A" designation.*** All scoring and rationale for each Risk Indicator is provided in Appendix A.

Analyst Notes

The Melville BD Zone presents several strong assets. These include a lack of competition for wheat straw, a large BAM and a stable long term outlook on feedstock price and quantity. Risk of supplier breach for quanity is powerfully mitigated by signifciant redundency of supply available at a marginal increase in delivered cost.

Key Low and Moderate Risk Indicators

Most Loaded RI Scores are scored below 33.33 out of 100 and are thus considered *low* risk.

Risks related to competition are all scored as *low*. This is primarily a result of that fact that there are no large-scale facilities consuming wheat straw within the 280 km competition zone surrounding Melville, SK that are currently in operation. Cattle feedlots are the only significant consumers of wheat straw in the region intaking ~2.5% of generated wheat straw in the BD Zone.

Risks related to potential feedstock availability are also scored *low*. Based on interviews with growers, two levels of participation rate are derived: *Expected*--58%, and *Low*-- 38%. When considering wheat production variation, the 1-in-20 year low, and grower participation rates, there are 306,878 ODMT/yr of potentially available feedstock within 90 km in the *expected* participation scenario; and 297,024 ODMT/yr of potentially available feedstock within 110 km in the *low* participation scenario.

We assess the Loaded RI Score of Risk Indicator *3.6.1: Number, Size Mix and Locations of Suppliers*, which scored at 49.95, as *moderate.* Most farms in the Melville BD Zone tend to be small. Even if the larger farms can be brought, large bio-based projects may require aggregations of more than 150 individual growers. The degree of management complexity for this is significant; however, it is likely manageable. A large pool of suppliers will also bring with it positive supply chain attributes, as the presence of many suppliers can function to increase supply chain resilience. That is, a breach by a few suppliers would not significantly impact the supply of feedstock to a project.

We assess the Loaded RI Score of Risk Indicator *1.9.1: Feedstock Production Priority* which scores at 52.45, as *moderate*. The initial survey indicated a lack of interest from large growers. This could be a function of a limited outreach methodology or of the possibility that growers are more amenable to face-to-face meetings, something that was not possible for this BD Zone Rating due to travel restrictions from COVID-19. It is reasonable to assume that larger "anchor" suppliers would eventually indicate interest in supplying if approached by a credible new market for wheat straw.

Key High-*Risk* Indicators

Most significant risks in the Melville wheat straw supply chain are classified into two categories: 1) risks related to harvesting / collection equipment, and 2) risks related to natural events.

Harvesting, Collection and Equipment Risk Indicators

Due to a current lack of markets for wheat straw in the region, suppliers in the Melville BD Zone are generally inexperienced in the harvesting and baling of wheat straw. In addition, few growers presently own the baling equipment that is ideal for storage and delvery of wheat straw; square balers. Instead, round balers are far more commonly used. Differences in baling equipment and harvest practices

among growers may result in significant varience in delivered feedstock quality.

The risks around harvesting / collection equipment can be substantially mitigated by the vertical intergation of a bio-project with wheat straw harvest / baling processes, or by engagement of a credible third-party to carry out harvest / baling activities. The cost of implementing such measures is estimated at $10-$20/ODMT.[2, 3]

We assume that bio-based projects that locate in the Melville BD Zone will likely take measures to mitigate key risks. This expectation is indicated by the difference between Raw RI scores and Notched Salience scores for multiple Risk Indicators detailed in Appendix A.

Moderate scale up risk is present for any project in the Melville BD Zone, resulting in a Loaded RI Score for RI *5.1.2 Capacity of Supply Chain Components and Equipment to Scale* of 75. This indicator presents a moderate but salient risk even with mitigation measures, and a high impact if mitigation measures were to fail.

Natural Event Risk Indicators

Natural events can have a significant impact on wheat straw supply in the Melville BD Zone, and this category of risk presents the highest risk scores for this BD Zone rating. The Loaded RI Score of RI *3.7.1 Seasonal Weather Impacts on Feedstock Supply* is 35. It is recognized however that specific projects may be able to effectively mitigate RI 3.7.1 through the use of indoor storage for greater quantities of baled wheat straw.

Other *moderate* Risk Indicators, scoring between 33.33 and 66.66, include *3.7.2 Long-Term Weather and Climate Trends; 3.7.4 Risk of Infestation;* and *3.7.5-9 Risk of Hail, Flood, Drought, Hurricanes, Tornadoes, Strong Winds, and Low Temperatures.* Mitigation measures can be limited in degree based on their abilty to address natural risk. Despite this, a large BAM for wheat straw in the Melville BD Zone and the relatively low impact of additional transport cost on the landed cost of feedstock are material mitigating considerations-- as can be seen in the large difference between Raw RI Scores and Notched Salience scores for Natural Event related Risk Indicators.

BD Ratings Parameters

In the interest of avoiding undue market influence and prejudicing a project's ability to negotiate with suppliers, BD Zone rating reports do not provide information on total feedstock cost breakdowns obtained throughout the assessment. This includes all costs associated with the engagement of a third-party, as well as the development of a vertically integrated supply chain.

For the purpose of this rating, growers' "ask" prices were solicited and baling costs were evaluated. Transportation costs were also calculated using average distances based on the supply curves and using trucking costs typical for the region.

The rating of the Melville BD Zone is based on total delivered costs of feedstock of $65-$90/ODMT at a distance range of 90-110 km and for a total of 200,000 – 300,000 ODMT.

Infrastructure Asset Profile

The City of Melville's infrastructure assets were scored on a scale of 0 - 10, with scores defined as follows: 0 (*insufficient*), 2 (*poor*), 4 (*fair*), 6 (*reasonable*), 8 (*good*), 10 (*very good*). 74% of all assets scored as either *good* or *very good*, and 0 scored as *poor* or *insuffucient*. Among the top rated assets are the ease of local rail and highway access, and the safe and vibrant local community. Among the lowest rated assets is the existing (lack of) plant infrastructure. Overall, the City of Melville presents a profile of positively rated infrastructure assets, with an average score of **7.53**. This score supplements the City of Melville's BD Zone rating, and reinforces it's **A** (*low risk*) designation. The full infrastructure asset profile is detailed in *Table 2*. A full site selection analysis can be found in Appendix D.

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[2] Estimate comes from discussions with third party balers / harvesters (e.g., Pacific Ag.)

[3] This price range only applies to the engagement of a third-party baler / harvester. Assessment of the cost for vertical supply chain integration was not within the scope of this BD Zone designation.

Figure 1 - Risk Indicators (sorted by risk level)

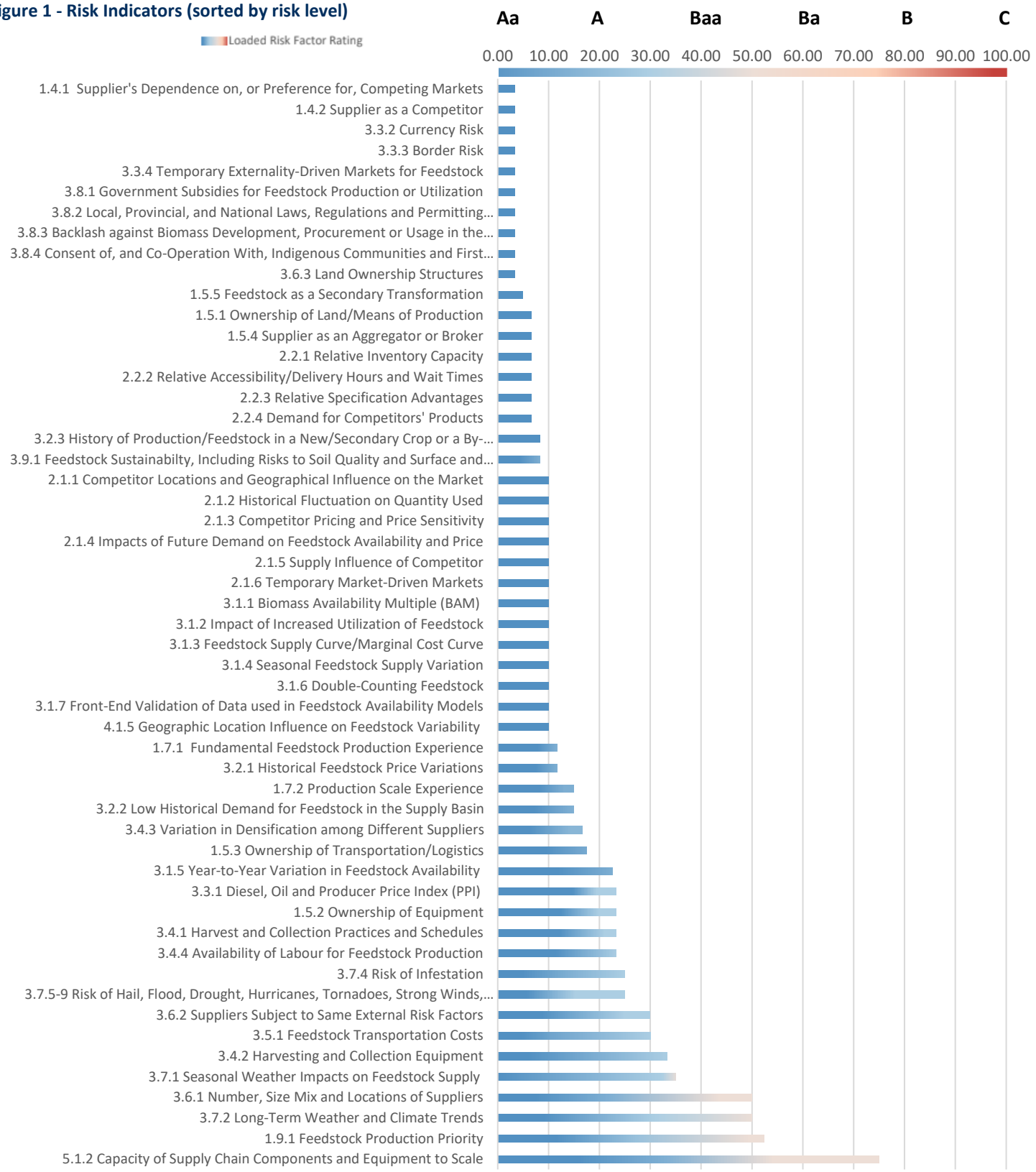


Figure 2 - Risk Indicators (sorted numerically)

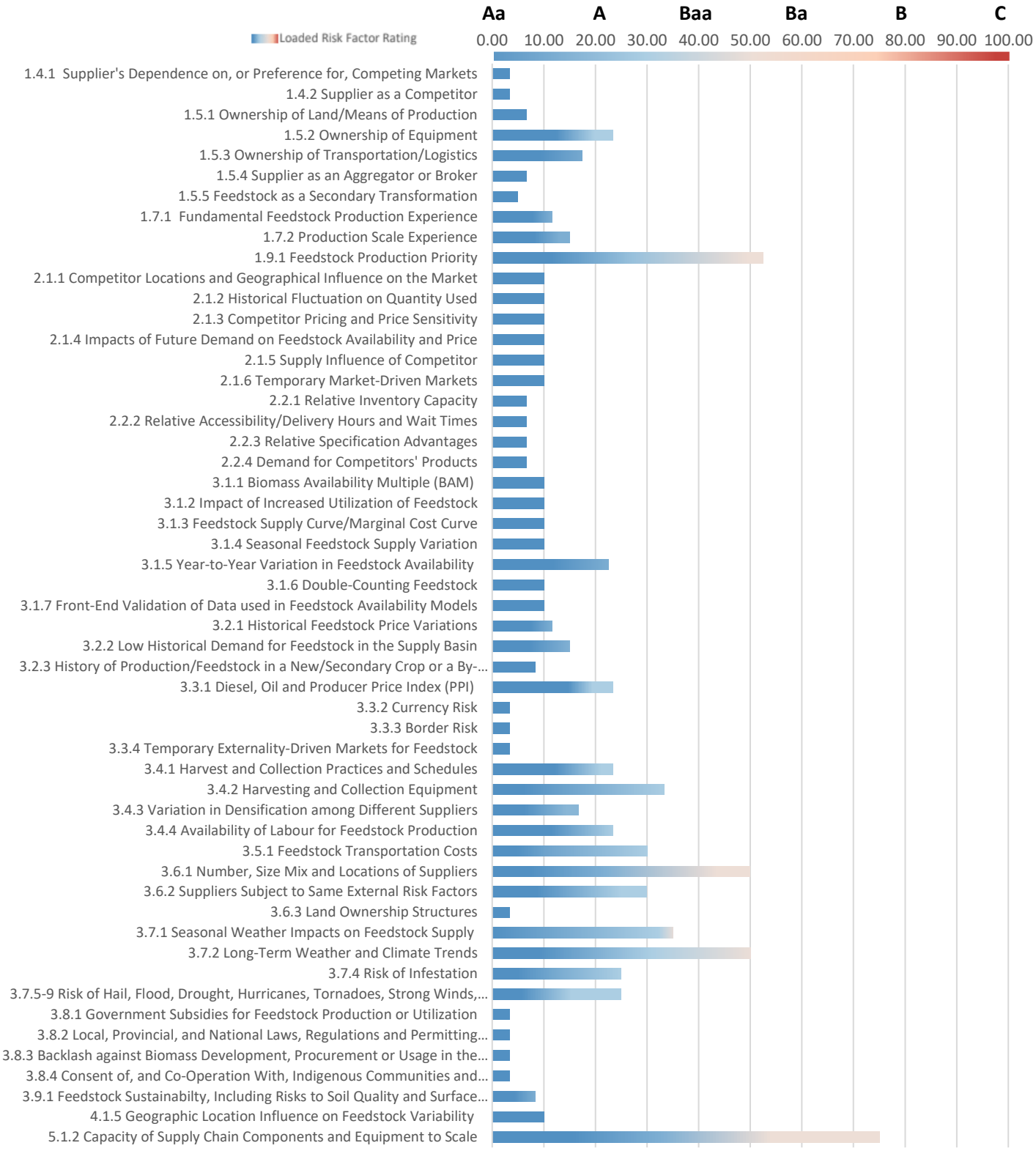


Table 1 - Risk Indicators

Feedstock Supply Chain Risk Indicators	Raw RI Score	Notched Salience	Impact Level	Loaded RI Score
1.4.1 Supplier's Dependence on, or Preference for, Competing Markets	1	1.0	3.33	3.33
1.4.2 Supplier as a Competitor	1	1.0	3.33	3.33
1.5.1 Ownership of Land/Means of Production	1	1.0	6.66	6.66
1.5.2 Ownership of Equipment	7	3.5	6.66	23.31
1.5.3 Ownership of Transportation/Logistics	7	1.75	9.99	17.48
1.5.4 Supplier as an Aggregator or Broker	1	1.0	6.66	6.66
1.5.5 Feedstock as a Secondary Transformation	3	0.75	6.66	5.00
1.7.1 Fundamental Feedstock Production Experience	7	3.5	3.33	11.66
1.7.2 Production Scale Experience	9	4.5	3.33	14.99
1.9.1 Feedstock Production Priority	7	5.25	9.99	52.45
2.1.1 Competitor Locations and Geographical Influence on the Market	1	1.0	9.99	9.99
2.1.2 Historical Fluctuation on Quantity Used	1	1.0	9.99	9.99
2.1.3 Competitor Pricing and Price Sensitivity	1	1.0	9.99	9.99
2.1.4 Impacts of Future Demand on Feedstock Availability and Price	1	1.0	9.99	9.99
2.1.5 Supply Influence of Competitor	1	1.0	9.99	9.99
2.1.6 Temporary Market-Driven Markets	1	1.0	9.99	9.99
2.2.1 Relative Inventory Capacity	1	1.0	6.66	6.66
2.2.2 Relative Accessibility/Delivery Hours and Wait Times	1	1.0	6.66	6.66
2.2.3 Relative Specification Advantages	1	1.0	6.66	6.66
2.2.4 Demand for Competitors' Products	1	1.0	6.66	6.66
3.1.1 Biomass Availability Multiple (BAM)	1	1.0	9.99	9.99
3.1.2 Impact of Increased Utilization of Feedstock	1	1.0	9.99	9.99
3.1.3 Feedstock Supply Curve/Marginal Cost Curve	1	1.0	9.99	9.99
3.1.4 Seasonal Feedstock Supply Variation	1	1.0	9.99	9.99
3.1.5 Year-to-Year Variation in Feedstock Availability	9	2.25	9.99	22.50
3.1.6 Double-Counting Feedstock	1	1.0	9.99	9.99
3.1.7 Front-End Validation of Data used in Feedstock Availability Models	1	1.0	9.99	9.99
3.2.1 Historical Feedstock Price Variations	7	3.5	3.33	11.66
3.2.2 Low Historical Demand for Feedstock in the Supply Basin	9	4.5	3.33	14.99
3.2.3 History of Production/Feedstock in a New/Secondary Crop or a By-Product	10	2.5	3.33	8.33
3.3.1 Diesel, Oil and Producer Price Index (PPI)	2	2.0	3.33	6.66
3.3.2 Currency Risk	1	1.0	3.33	3.33
3.3.3 Border Risk	1	1.0	3.33	3.33
3.3.4 Temporary Externality-Driven Markets for Feedstock	1	1.0	3.33	3.33
3.4.1 Harvest and Collection Practices and Schedules	7	3.5	6.66	23.31
3.4.2 Harvesting and Collection Equipment	10	5.0	6.66	33.30
3.4.3 Variation in Densification among Different Suppliers	5	2.5	6.66	16.65
3.4.4 Availability of Labour for Feedstock Production	7	3.5	6.66	23.31
3.5.1 Feedstock Transportation Costs	3	3.0	9.99	30.00
3.6.1 Number, Size Mix and Locations of Suppliers	5	7.5	6.66	49.95
3.6.2 Suppliers Subject to Same External Risk Factors	9	4.5	6.66	29.97
3.6.3 Land Ownership Structures	1	1.0	3.33	3.33
3.7.1 Seasonal Weather Impacts on Feedstock Supply	7	3.5	9.99	35.00
3.7.2 Long-Term Weather and Climate Trends	5	5.0	9.99	50.00
3.7.4 Risk of Infestation	2.5	2.5	9.99	25.00
3.7.5-9 Risk of hail, flood, drought, hurricanes, tornadoes, and strong winds, and low temperatures	2.5	2.5	9.99	25.00
3.8.1 Government Subsidies for Feedstock Production or Utilization	1	1.0	3.33	3.33
3.8.2 Local, Provincial, and National Laws, Regulations and Permitting pertaining to Biomass	1	1.0	3.33	3.33
3.8.3 Backlash against Biomass Development, Procurement or Usage in the Region	1	1.0	3.33	3.33
3.8.4 Consent of, and Co-Operation With, Indigenous Communities and First Nations	1	1.0	3.33	3.33
3.9.1 Feedstock Sustainability, including risks to soil quality and surface and groundwaters.	5	2.5	3.33	8.33
4.1.5 Geographic Location Influence on Feedstock Variability	1	1.0	9.99	9.99
5.1.2 Capacity of Supply Chain Components and Equipment to Scale	10	7.5	9.99	75.00

Table 2 - Asset Indicators

Infrastructure Assets	Overview	Score
Category 1: Physical Infrastructure		
1.1 Land Parcel	55 + Acres. Site A-1. Intended as Phase 1 of the Melville Industrial Strategy.	8
1.2 City Ownership	City owns and/or intends to acquire all lands for industrial purposes.	4
1.3 Industrial Land Use Zone	Lands to be rezoned by the City to Industrial for medium and heavy uses.	6
1.4 Natural Gas Line	210 GJ/hr. Major transmission line and gas storage caverns in close proximity - prelim pricing underway.	8
1.5 Electrical	25 MVA. Major transmission line in close proximity - prelim pricing underway.	8
1.6 Fresh Water Supply Line	2400 litres/minute [3456 m3 /day]. New 2020 reverse osmosis plant - surplus capacity for industrial and residential needs of City.	8
1.7 Sewage Disposal Trunk Line	1400 litres/minute [2016 m3 /day]. Engineering studies underway to upgrade wastewater treatment. Priority.	6
1.8 Drainage	Drainage study completed for general area - specific plans to be developed later.	6
1.9 Stormwater Management	Stormwater management completed for general area - specific plans later.	8
1.10 Natural Gas Power Generation Site	Sufficient industrial land for natural gas generation. City will look for buyers of power.	8
1.11 Available ICT Services	Good.	8
1.12 Available Land	Good - all land is "greenfield" and the Phase 1 Industrial Park Strategy site plans are flexible.	8
1.13 Cost of Land - Initial Cost	Offered by City at cost - with other incentives to be negotiated.	8
1.14 Cost of Land - Property Tax, Utilities	Offered by City at cost - with other incentives to be negotiated.	6
1.15 Infrastructure - Pre-existing Plant Infrastructure	No pre-existing plant infrastructure. "Greenfield" situation will enable custom-designed site.	4
1.16 Infrastructure - Landfill/waste disposal	New, approved landfill. Considering windrow composting facility for Red Leaf.	8
Category 2: Logistics		
2.1 Railway Spur Line	Railway abuts property. CN Rail being contacted regarding a tie-in to an abutting railway line.	6
2.2 Highway Access and Intersection	Junction of 3 highways. In preliminary discussions with Highways and Transportation on access points.	10
2.3 Proximity to Major Markets	Good rail and road transportation - good "back-haul " rates to USA via semi-trailer trucks.	8
2.4 Inbound/Outbound Shipping Costs	Good.	8
2.5 Accessibility to Airport	Reasonable. Regina is 90 minutes. Yorkton Airport supports private jets. Helipad on site.	6
2.6 Railway Service	CN Rail mainline with CN and CP branch lines connecting to Regina, Saskatoon etc.	10
2.7 Logistics - Construction Logistics	Good. Considering a possible work camp during construction period.	8
2.8 Logistics - Proximity KCO3	Main transportation hub for the potash mines at Esterhazy.	8
Category 3: Social Infrastructure		
3.1 Quality of Life	Family-friendly. Good education and sports. Cabin and boating lake 20 minutes away.	8
3.2 Education - Elementary & High School	Good. Public, Catholic and French-Immersion. Childcare averages under $600 per month. Comprehensive High School with wide range of academic and trades education.	8
3.3 Education - Post Secondary	Good. University of Regina is 90 minutes away. Offers some first-year classes. Includes provincial fireman school.	6
3.4 Local Retail	Fair. City working on a Downtown Revitalization Plan. Highway Commercial Retail is strong.	6
3.5 Culture and Recreation	Excellent sports facilities, boating lake 20 minutes away. Several clubs.	10
3.6 Hospital and Doctors	Accredited Acute Care Regional Hospital with 4 doctors & 90 staff. STARS helicopter.	8
3.7 Housing Availability	Good. Major new residential subdivision in planning stage for 2021 development.	6
3.8 Crime Rate	Very low crime. RCMP detachment in the City.	10
Category 4: Workforce		
4.1 Labour Costs	Good.	8
4.2 Available Skilled Labour	Good.	8
4.3 Available Unskilled Labour	Good. Agricultural producers will be a good, reliable source.	8
4.4 Training Programs / Community College	Community College in Melville. Dedicated training courses possible.	8
4.5 Workforce - Population Support/Size of Workforce	Good. City and residents interested in new industrial growth. Support for local retail.	8
4.6 Workforce - Community Impact	Good. City and residents interested in new industrial growth. Support for local retail.	8
4.7 Workforce - EA Impact - Public Opinion	Melville is a long-time railway town - is used by industrial users.	8
4.8 Workforce - Labour Cost	Good.	8
Category: 5 Financial		
5.1 Corporate Tax Rate (Saskatchewan)	Good. 12% with reductions possible for Saskatchewan-based investments.	8
5.2 Construction Costs	Good.	8
5.3 Provincial Incentives	Need to be researched further - expect strong support from Province.	6
5.4 Municipal Incentives	Yes. Fair and equitable for both Red Leaf and other medium and heavy industrial companies.	8
5.5 Energy Availability and Costs	Good - specific unit costs pending.	8
5.6 Environmental Regulations	Details subject to Saskatchewan Environment requirements. Expect support.	6
5.7 Expedited Permit Process	Good. City will expedite. Engineering and city planning consultants on retainer now.	8
	Total	***7.53***



Biofuel Development Zone Program Advisory Group

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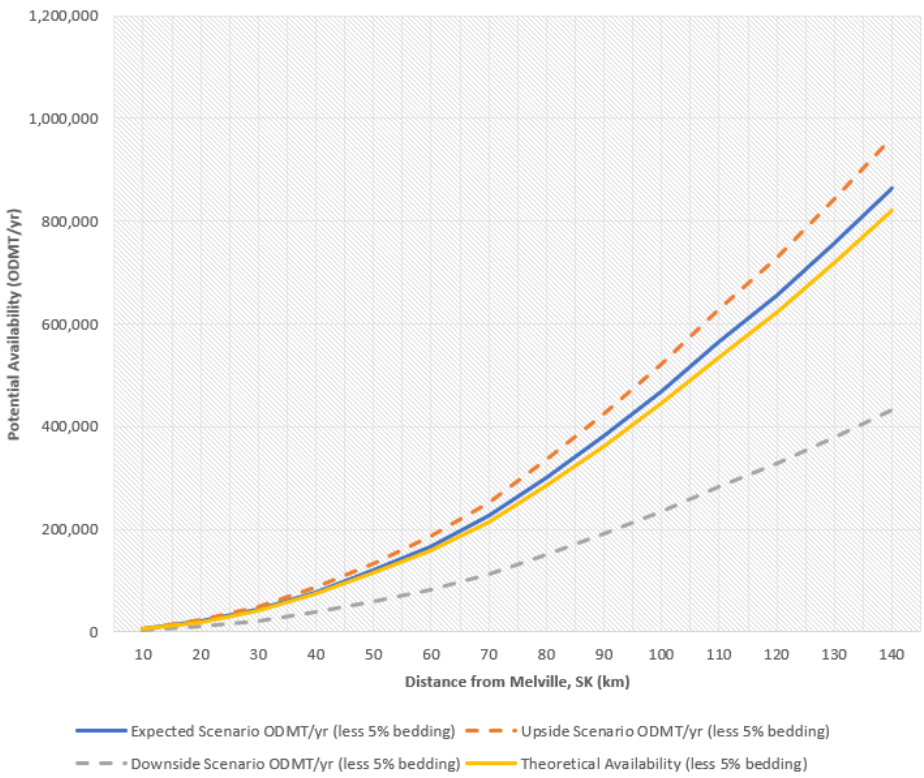
APPENDIX A: Scoring Protocols, Rationale and Ratings

Risk Indicator 1.4.1	Supplier's Dependence On, or Preference For, Competing Markets	Score
Reporting Requirements / Recommendations	REQUIREMENTS: Proponent shall demonstrate understanding of: 1. Competing markets including, at minimum; approximate quantities, percentage of total supplier feedstock production and competing market's demand, and length of time supplied if supplier provides feedstock to competing markets. 2. The quantity and relevance of the risk of leverage a competing market could exert on a supplier if that supplier provides feedstock and any other products or by-products to such competing markets. RECOMMENDATIONS: 1. Proponent should demonstrate understanding of supplier's relationship with competing markets, if possible.	
Raw RI Score	There are no large-scale consumers of wheat straw in the region. The cattle bedding and feed market is estimated to consume approximately 2.5% of all generated wheat straw. Although some wheat growers also raise cattle, the bedding and feed market is too small to pose a significant risk. Raw RI Score is deemed *low.*	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed moderate.	**3.33**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 3.33 out of 100.	**3.33**

Risk Indicator 1.4.2	Supplier as a Competitor	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Proponent shall determine if supplier is also a competitor. If so, determine degree to which Proponent relies on that supplier. If loss of feedstock supply can materially impact Proponent, supply chain redundancy or other mitigation measures shall be understood.	
Raw RI Score	Some suppliers also raise cattle and use wheat straw for bedding and feed. However, the cattle bedding and feed market is too small to pose a significant risk. Raw RI Score is deemed *low.*	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed *low*.	**3.33**
Loaded RI Score	Loaded risk score (Notched Salience x Impact Level) is 3.33 out of 100.	**3.33**

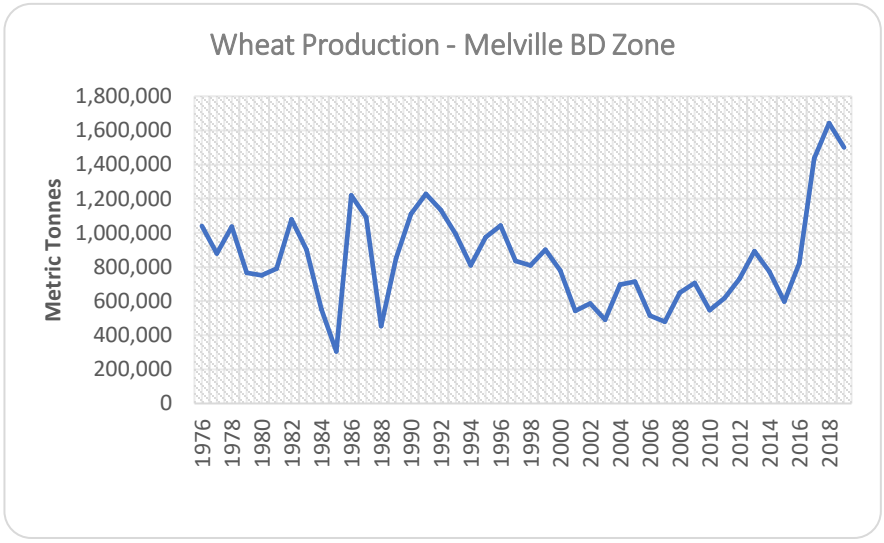
Risk Indicator 1.5.1	Ownership of Land/Means of Production	Score
Reporting Requirements / Recommendations	REQUIREMENTS: Proponent shall demonstrate understanding of: 1. Supplier's land/facility ownership. 2. Suitable control measures in cases where the supplier does not own/lease land/facility where feedstock is produced.	
Raw RI Score	The vast majority of (if not all) suppliers own land on which they grow wheat. Raw RI Score is deemed *low.*	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed medium.	**6.66**
Loaded RI Score	Loaded risk score (Notched Salience x Impact Level) is 6.66 out of 100.	**6.66**

Risk Indicator 1.5.2	Ownership of Equipment	Score
Reporting Requirements / Recommendations	REQUIREMENTS: Proponent shall demonstrate understanding of: 1. Supplier's equipment ownership. 2. The risk of using a third-party's equipment in cases where the supplier does not own/lease equipment. RECOMMENDATIONS: 1. Proponent should demonstrate precedent for the use of a third-party's harvesting, collection and transportation services.	
Raw RI Score	Only 25% of grain growers interviewed currently own baling equipment. Although this is intuitive as there is currently no market for baled wheat straw, in the absence of a project providing harvesting / collection services, or a significant incentive for growers to purchase suitable equipment, growers may be hesitant to purchase such equipment en-masse. Timely mitigation of this risk will require involvement of a third-party baling company; at least initially until growers invest in baling equipment. There are two major risks associated with engaging third-parties. Firstly, feedstock costs will increase significantly and the costs associated with the use of a third-party baler could be substantially higher than estimated in this report. Secondly, not all growers will accept harvest of wheat straw by third parties: grower participation rates could be lower than expected. Raw RI score is *moderate/high*.	**7**
Notched Salience	RI 1.5.2 could be *significantly* mitigated by the involvement of an experienced third-party baling company (or companies). The additional cost associated with engaging such a third-party (or by vertically integrating a similar service within a project) is estimated at $10- $20/ODMT. This addition to feedstock cost has been incorporated into the feedstock cost range on which this rating is based. The risk posed by a lack of precedent and farmer reticence to allow third-party balers on their land is taken into account with the assumptions of low-end participation rate (38%) which is based on on-the-ground feedback and the fact that, even at this lower participation rate, 300,000 ODMT of feedstock is likely available in the BD Zone. As a result, the Raw RI Score is notched by 50%: Notched Salience is 3.5.	**3.5**

	Figure 8: *Expected*, *Downside*, and *Upside* scenarios assuming a 38% participation rate 	
Impact Level	RI Impact Level is deemed medium.	**6.66**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 23.31 out of 100.	**23.31**

Risk Indicator 1.5.3	Ownership of Transportation/Logistics	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Proponent shall demonstrate understanding of the risk of using third-parties, both in cases where supplier provides transportation but does not own/lease the means of transportation, and in cases where transportation is provided by Proponent (or contracted to a third-party by Proponent). RECOMMENDATIONS: 1. Proponent should demonstrate precedent for the use of a third-party's transportation services.	
Raw RI Score	Due to the lack of large-scale markets for wheat straw, there is a resulting and expected lack of trucking companies specialized in transporting straw present in the region. Any wheat straw that is currently being sold is transported by the growers (i.e., mostly cattle growers), but the total number of trucks and trailers owned by these growers is not sufficient to support a large consumer of straw. Although growers may invest in equipment once demand increases and confidence grows in stability, the lack of widespread ownership of transportation equipment and the likely need to hire third-party transportation companies is a distinct risk to the supply chain. This risk becomes more significant considering the fact that the harvesting season lasts only a few weeks, and sufficient transport equipment would have to be moved into the region for only a short time. This risk is partly mitigated by the fact that there is a difference in the harvesting seasons of about four weeks between the southern and northern parts of the Melville supply basin. Nonetheless, the Raw RI score is deemed *moderate/high*.	**7**
Notched Salience	RI 1.5.3 could be *broadly* mitigated as sufficient transport equipment can likely be brought from other regions and provinces. Multiple established trucking companies currently transport other products using flatbed trailers, which are capable of transporting bales. Verbal interviews with several trucking companies indicated that the existing trucking infrastructure should be able to support a large-scale project, given that trucks could be moved into the region from other areas in Saskatchewan and Manitoba (and potentially Alberta). As a result, the Raw RI Score is notched by 75%: Notched Salience is 1.75.	**1.75**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded risk score (Notched Salience x Impact Level) is 17.48 out of 100.	**17.48**

Risk Indicator 1.5.4	Supplier as an Aggregator or Broker	Score
Reporting Requirements / Recommendations	REQUIREMENTS: Proponent shall demonstrate understanding of: 1. Intermediary's sources of supply. 2. Intermediary's control over sub-contractors. 3. How intermediary can mitigate risk of breach by individual sub-contractors. 4. Ability of intermediary to warrant supply of feedstock.	
Raw RI Score	There is at least one aggregator (i.e., Johnston's grain) who expressed willingness to aggregate feedstock for a project located in the Melville region. It is unknown whether that aggregator would be willing to guarantee feedstock supply, and at what premium. However, due to the presence of a large number of growers which allows for the spread of supply sources and decreases supply shortage risks, the use of an aggregator is likely not necessary. Raw RI Score is deemed *low*.	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed medium.	**6.66**
Loaded RI Score	Loaded risk score (Notched Salience x Impact Level) is 6.66 out of 100.	**6.66**

Risk Indicator 1.5.5	Feedstock as a Secondary Transformation	Score
Reporting Requirements / Recommendations	REQUIREMENTS: Proponent shall demonstrate understanding of: 1. Relationship between the primary product and the secondary transformation. 2. Historical and projected market demand for supplier's primary product. 3. The sensitivity of biomass feedstock production to demand fluctuations of the primary product.	
Raw RI Score	Feedstock is a by-product of a primary crop -- wheat. It will therefore always be a priority for producers to produce wheat grain first, with straw being a potential secondary by-product. Additionally, many growers use wheat straw as fertilizer. There is a direct relationship between feedstock and the primary product: wheat straw makes up between 60% and 80% of grain yield by weight. The figure below illustrates historical wheat production in the supply basin. The data indicate that despite significant decline in production between 1992 and 2015, wheat production has increased significantly since 2015. Therefore, since generation of wheat straw is directly related to wheat production, wheat straw generation has also increased. Raw RI Score is deemed *low/moderate.* 	**3**
Notched Salience	RI 1.5.5 could be *broadly* mitigated by expanding the supply basin. In case of shortages due to low wheat production, more feedstock can likely be procured from areas outside than the initial supply basin. The cost of additional transportation is relatively low compared to the total cost of feedstock (e.g., at 50 km from Melville the transportation cost makes up 13% of the total cost). On-site inventory of >18 months' worth of feedstock could also be maintained under cover to further mitigate wheat harvest shortfalls. As a result, the Raw RI Score is notched by 75%: Notched Salience is 0.75.	**0.75**
Impact Level	RI Impact Level is deemed medium.	**6.66**
Loaded RI Score	Loaded risk score (Notched Salience x Impact Level) is 5.00 out of 100.	**5.00**

Risk Indicator 1.7.1	Fundamental Feedstock Production Experience	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. In situations where suppliers are inexperienced with any area of biomass feedstock production, a comprehensive protocol that documents best practices and training shall be provided by the Proponent. 2. Certain stages for biomass production should be outsourced to a specialized company if warranted.	
Raw RI Score	The supply chain is only somewhat experienced in producing wheat straw, with the cattle bedding and feed market being the only consumer. Many individual growers have never baled their wheat straw, although some have baled straw from other crops. Raw RI Score is deemed *moderate/high.*	**7**
Notched Salience	RI 1.7.1 could be *significantly* mitigated through the involvement of an experienced third-party baling company (or companies), or by provision of similar services through the establishment of a vertically integrated bio-project. As a result, the Raw RI Score is notched by 50%: Notched Salience is 3.5.	**3.5**
Impact Level	RI Impact Level is deemed *low*.	**3.33**
Loaded RI Score	Loaded risk score (Notched Salience x Impact Level) is 11.66 out of 100.	**11.66**

Risk Indicator 1.7.2	Production Scale Experience	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Proponent shall demonstrate understanding of whether supplier commitments exceed current outputs and if so, whether such commitments exceed capacity to produce with current equipment, manpower and supply/customer base.	
Raw RI Score	There is a lack of production-scale experience for wheat straw in the supply chain. Scale-up from current wheat straw production levels to production levels required for a large-scale facility would be significant. Raw RI Score is deemed *high.*	**9**
Notched Salience	RI 1.7.2 could be *significantly* mitigated by outsourcing harvest and collection to a credible third-party baling company or by provision of similar services through a vertically integrated bio-project. As a result, the Raw RI Score is notched by 50%: Notched Salience is 4.5.	**4.5**
Impact Level	RI Impact Level is deemed *low*.	**3.33**
Loaded RI Score	Loaded risk score (Notched Salience x Impact Level) is 14.99 out of 100.	**14.99**

Risk Indicator 1.9.1	Feedstock Production Priority	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Proponent shall determine relative importance of contracted feedstock production to supplier, especially whether production of feedstock is low margin, or if it is relatively small additional net profit to the supplier. 2. Proponent shall understand and model the harvesting window for the primary crop. If that harvesting window is small then Proponent should understand the potential of the residue harvesting and collection being ignored by the grower.	
Raw RI Score	Based on interviews with a sample of suppliers, where growers indicated willingness to supply, they also indicated that wheat straw could become a significant source of on-farm income. Growers reluctant to supply indicated that there is a cost associated with fertilizer replacement when wheat straw is removed from the field, and that wheat straw price would need to be high in order for them to consider supplying it. In both cases, wheat straw production is not a priority for growers. Two of the largest growers surveyed for this project, cumulatively representing 47% of potential wheat straw supply surveyed, were not interested in supplying wheat straw (note that this could be a result of the fact that outreach was conducted by phone, not in person). This risk is further compounded by the fact that there is a relatively short harvesting window: 4 to 6 weeks. Therefore, suppliers will prioritize grain production and will only supply wheat straw if it does not impede their ability to efficiently harvest grain. Raw RI Score is deemed *moderate/high.*	**7**
Notched Salience	RI 1.9.1 could be *moderately* mitigated by face-to-face meetings with potential suppliers, something that was not possible due to COVID-19, but could result in more favorable feedback from large growers. Further, outsourcing harvest and collection to a credible third-party baling company, or by provision of similar services through a vertically integrated bio-project, could also mitigate this risk. As a result, the Raw RI Score is notched by 25%: Notched Salience is 5.25.	**5.25**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded risk score (Notched Salience x Impact Level) is 52.45 out of 100.	**52.45**

Risk Indicator 2.1.1	Competitor Locations and Geographical Influence on the Market	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Proponent shall demonstrate an understanding of the competitor's location relative to the Proponent, and its impact on feedstock supply. This shall include an evaluation of competitor's ability to short-haul the Proponent and otherwise exert pressure on local suppliers.	
Raw RI Score	There are no large-scale competitors for wheat straw in the region. Raw RI Score is deemed *low.*	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded risk score (Notched Salience x Impact Level) is 9.99 out of 100.	**9.99**

Risk Indicator 2.1.2	Historical Fluctuation of Quantity Used	Score
Reporting Requirements / Recommendations	REQUIREMENTS: Proponent shall demonstrate understanding of: 1. Current key competitor intake quantities for each type of feedstock used by the competitor. 2. Current key competitor intake quantities for each type of linked feedstock. RECOMMENDATIONS: Proponent should demonstrate understanding of: 1. Historical utilization of each type of feedstock used by the Proponent. 2. Historical competitor intake quantities for each type of linked feedstock.	
Raw RI Score	There are no major current or historical competitors for wheat straw in the area. The only current consumers of wheat straw in the area are the cattle bedding and feed markets. However, they are estimated to consume a total of only 2.5% of all generated wheat straw. Therefore, Raw RI Score is deemed *low.*	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded risk score (Notched Salience x Impact Level) is 9.99 out of 100.	**9.99**

Risk Indicator 2.1.3	Competitor Pricing and Price Sensitivity	Score
Reporting Requirements / Recommendations	REQUIREMENTS: Proponent shall demonstrate understanding of: 1. Current price paid by competitors for feedstocks used by Proponent. 2. Historical feedstock price paid by the competitor. If significant price fluctuation has occurred, then Proponent shall demonstrate understanding of factors driving such fluctuation. 3. The market for competitors' end products and any relationship between this market and the ability of competitor to drive feedstock price over time. RECOMMENDATION: Proponent should demonstrate understanding of: 1. Current price paid by competitors for linked feedstocks. 2. Competitor's sensitivity to price increases. 3. Competitor's track record of driving feedstock cost during periods of shortage. 4. Payment terms. 5. Payment history.	
Raw RI Score	There are no significant competitors for wheat straw in the region. Raw RI Score is deemed *low.*	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 9.99 out of 100.	**9.99**

Risk Indicator 2.1.4	Impacts of Future Demand on Feedstock Availability and Price	Score
Reporting Requirements / Recommendations	REQUIREMENTS: Proponent shall demonstrate understanding of: 1. Forecasted new demand on feedstock availability and price; impact of any proposed competitors or ones currently under construction (including currently operating competitors that have indicated potential expansion). 2. Non-forecasted but potential new demand on feedstock. RECOMMENDATIONS: 1. Proponent should demonstrate understanding of conditions in which a competitor is likely to expand operations and/or barriers to entry for new competitors for feedstock.	
Raw RI Score	There are no proposed large-scale potential competitors for wheat straw. Wheat straw is widely available throughout the province. The risk that, once a project sites in the BD Zone, there will be an additional project (above intake requirements of 300,000 ODMT/yr) siting in the same BD Zone is low. Due to the relatively low quality of wheat straw compared to other types of straw (e.g., flax, oat, etc.), the cattle bedding and feed market for wheat straw is unlikely to grow significantly in the future. Raw RI Score is deemed *low.*	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 9.99 out of 100.	**9.99**

Risk Indicator 2.1.5	Supply Influence of Competitor	Score
Reporting Requirements / Recommendations	REQUIREMENTS: Proponent shall demonstrate understanding of: 1. The proportion of supply that the competitor can control. 2. Historical occurrences where a competitor exerted control over supply.	
Raw RI Score	There are no large-scale competitors for wheat straw. Wheat straw is widely available throughout the province and therefore it is unlikely that competitors for wheat straw (i.e., intake requirements of >300,000 ODMT/yr) will locate in the same BD Zone. Raw RI Score is deemed *low.*	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 9.99 out of 100.	**9.99**

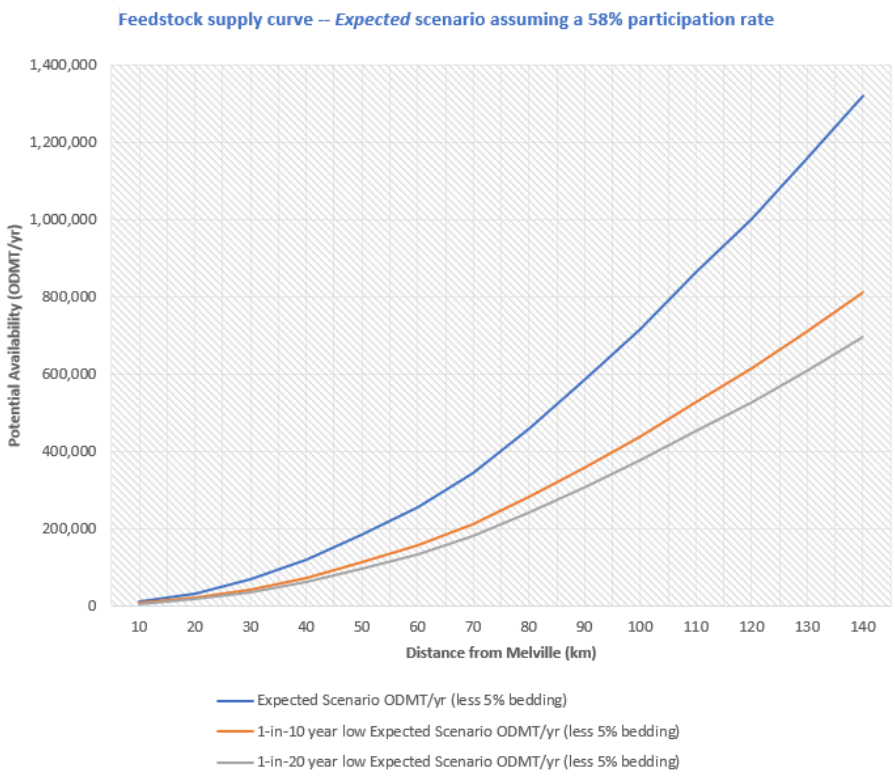
Risk Indicator 2.1.6	Temporary Market-Driven Markets	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Any alternative, non-traditional and market-driven markets for feedstock shall be identified, and the likelihood of impact of these markets upon Proponent shall be assessed.	
Raw RI Score	There are no non-traditional or market-driven markets for feedstock. Raw RI Score is deemed *low.*	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 9.99 out of 100.	**9.99**

Risk Indicator 2.2.1	Relative Inventory Capacity	Score
Reporting Requirements / Recommendations	REQUIREMENTS: For each key competitor, Proponent shall demonstrate understanding of: 1. Quantities of feedstock inventory that can be stored by competitors. 2. Competitive advantage due to high inventory potential.	
Raw RI Score	There are no large-scale competitors for wheat straw. Cattle feedlots typically store up to one year of feedstock inventory. However, cattle feedlots are a relatively small market for wheat straw consuming only 2.5% of all generated feedstock. Raw RI Score is deemed *low.*	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed moderate.	**6.66**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 6.66 out of 100.	**6.66**

Risk Indicator 2.2.2	Relative Accessibility/Delivery Hours and Wait Times	Score
Reporting Requirements / Recommendations	REQUIREMENTS: For each key competitor, Proponent shall assess: 1. Discharge hours. 2. Average and maximum wait times to discharge. 3. Potential accessibility issues.	
Raw RI Score	There are no large-scale competitors for feedstock in the region. Raw RI Score is deemed *low.*	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed moderate.	**6.66**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 6.66 out of 100.	**6.66**

Risk Indicator 2.2.3	Relative Specification Advantages	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Proponent shall demonstrate understanding of the specifications for each category of competing feedstock relative to that of the Proponent, and shall assess the impact of any differences.	
Raw RI Score	There are no large-scale competitors for feedstock in the region. The cattle bedding and feed market has a high tolerance for feedstock quality (especially when used for bedding, which is in the majority of cases). However, the local cattle bedding and feed market is insignificant as it only accounts for 2.5% of all the wheat straw generated in the region. Raw RI Score is deemed *low.*	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed moderate.	**6.66**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 6.66 out of 100.	**6.66**

Risk Indicator 2.2.4	Demand for Competitors' Products	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Proponent shall demonstrate understanding of the market for competitors' products and its potential for increased demand.	
Raw RI Score	There are no large-scale competitors for wheat straw in the region. Raw RI Score is deemed *low.*	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed moderate.	**6.66**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 6.66 out of 100.	**6.66**

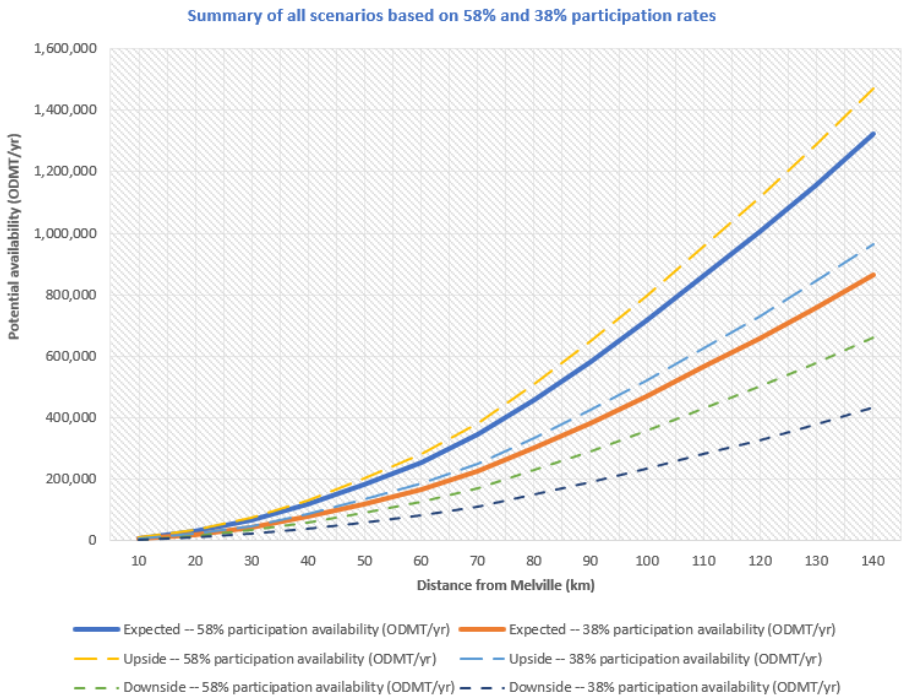
Risk Indicator 3.1.1	Biomass Availability Multiple (BAM)	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. The Proponent shall understand the Biomass Availability Multiple (BAM) for its project. 2. If more than one feedstock type is used, a separate BAM shall be understood for each feedstock type. 3. BAM shall be calculated based on feedstock which is realistically accessible for use by the Project ("Available Biomass"), rather than on theoretically available/modelled feedstock ("Produced Biomass"). 4. BAM shall be calculated within a band of economically feasible pricing as defined by the Proponent. Biomass feedstock that is available to a project shall be calculated using maximum price required to maintain ongoing operations and service financial covenants. 5. BAM shall be calculated using feedstock that is available to the Proponent in a timely manner so as to prevent operational disruptions. 6. Quality of redundant feedstock used in the calculation of BAM shall be useable by the Proponent. 7. BAM shall be calculated at a sufficiently detailed geographic resolution. RECOMMENDATIONS: 1. Demonstrated BAM should be at minimum 1.5, and preferably > 2.0.	
Raw RI Score	The Biomass Availability Multiple (BAM) is represented by projected availability and cost curves. BAM estimates were based on outreach to growers representing 27,750 ODMT/yr of feedstock. The potentially available feedstock participation rates, costs and distance curves can be found in detail in Appendix B of this rating. Raw RI Score is deemed *low.*  	**1**



Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 9.99 out of 100.	**9.99**

Risk Indicator 3.1.2	Impact of Increased Utilization of Feedstock	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Increased feedstock utilization scenarios shall be modeled to determine the impact of additional demand on Proponent feedstock supply and/or cost. Sensitivity analyses showing impact of increased feedstock utilization on Proponent shall be conducted. 2. Modeled demand scenarios should be realistic, conservative and justified. 3. If feedstock is a secondary transformation (e.g., forest residue) then the feedstock utilization scenarios shall be run based on the changes in demand for the primary product. RECOMMENDATIONS: 1. Scenarios reflecting potential increase in feedstock production in the long-term due to increased demand for feedstock should be considered.	
Raw RI Score	Increased feedstock utilization is represented by projected availability and cost curves, included in Appendix B of this rating. All conditions for calculating increased utilization of feedstock listed above are met. We assume that increased demand will likely drive production increase over time. Initially reluctant growers may become interested in supplying once a large-scale project demonstrates feedstock procurement reliability. In any case, high availability of wheat straw throughout the province renders this Raw RI Score *low*.	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 9.99 out of 100.	**9.99**

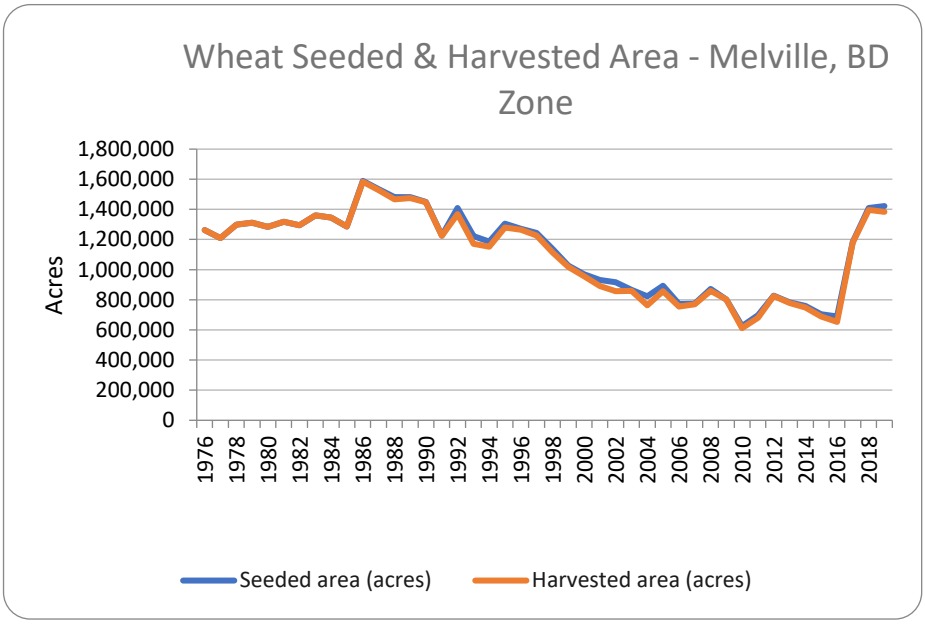
Risk Indicator 3.1.3	Feedstock Supply Curve / Marginal Cost Curve	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. A supply curve representing feedstock availability over price and distance shall be developed and any significant inflection points shall be adequately addressed. 2. If more than one feedstock type is used, then a separate cost curve shall be developed for each feedstock type. 3. Feedstock cost curve shall incorporate realistic quantities of feedstock actually available to the Proponent. Feedstock cost curve shall be calculated based on feedstock that is realistically accessible for use by the Proponent ("Available Biomass") rather than on theoretically available/modelled feedstock ("Produced Biomass"). 4. Feedstock cost curve shall be calculated within a band of economically feasible pricing as defined by the Proponent. Feedstock that is available to a project shall be calculated using maximum price required to maintain ongoing operations and service financial covenants. 5. Feedstock cost curve shall be calculated using feedstock available to the Proponent that is available in a timely manner so as to prevent operational disruptions. 6. Quality of redundant feedstock used in feedstock cost curve shall be useable by the Proponent. RECOMMENDATIONS: 1. Proponent should assess economic burden on the project procuring redundant feedstock (from larger distances) under *low*, medium and high supply chain stress scenarios.	
Raw RI Score	Supply curves representing feedstock availability based on price and distance are included in Appendix B of this rating. The supply curves include assumptions based on feedback from a sample of growers representing 27,750 ODMT/yr of potentially available feedstock. Therefore, the supply curves do not represent actual available biomass but rather an estimation of feedstock availability based on assumptions derived from a sample of potential suppliers. With that said, for the purposes of a BD Zone designation, this level of analysis should suffice. The supply curves included in Appendix B assess the economic burden on a project procuring redundant feedstock from larger distances and under different stress scenarios (i.e., participation rates). Raw RI Score is deemed *low*.	**1**



Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 9.99 out of 100.	**9.99**

Risk Indicator 3.1.4	Seasonal Feedstock Supply Variation	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Understanding of seasonal feedstock supply variation shall be demonstrated for each feedstock type. 2. A mitigation plan to lower the risk of seasonal feedstock supply variation should be demonstrated through one or more of the following methods: a) Inventory b) Feedstock substitution c) Feedstock supply optimization models.	
Raw RI Score	Wheat straw is only available at the time of wheat harvesting, which occurs between late August and early October. All wheat straw is harvested during those months. Therefore, there is no seasonal feedstock supply variation. The short harvest window risk has been accounted for in the score of RI 1.9.1 above. As a result, Raw RI Score for this risk indicator is deemed *low.*	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 9.99 out of 100.	**9.99**

Risk Indicator 3.1.5	Year-to-Year Variation in Feedstock Availability	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Projected year-to-year feedstock supply variation shall be modeled for each feedstock type. 2. Strategies to counteract estimates of year-to-year supply variation shall be developed. RECOMMENDATION: 1. Proponent should obtain historical data on yields of feedstock in the supply basin to make a determination of variability. If historical data are not available for predicting future yields, mathematical models may be used.	

Raw RI Score	Wheat straw is only available between late August and early October. There is a four-week spread in harvesting between the southern and northern parts of the Melville supply basin where harvesting begins an average of four weeks earlier in the northern regions of Melville relative to the southern regions. The harvesting window may vary from season to season due to weather. Year-to-year feedstock supply variation depends on the number of wheat acres planted, proportion of generated wheat left in the field, and the harvesting window. The number of wheat acres planted can vary from year to year due to market prices for wheat grain and other grains. Since grain is the main source of revenue for growers, they plan seeding times to maximize income. If growers expect wheat prices to decline, they would plant less wheat as a result. Similarly, if growers expect other crops to be more valuable, they would plant more of those and less wheat. The figure below shows annual variation of wheat seeded since 1976. Annual variations can be significant: between 2014 and 2015 there was a drop in seeded wheat by 25%, while between 2016 and 2017 there was an increase of 45%. These large variations pose a significant risk to wheat straw supply.  The risk is compounded by the fact that many growers leave wheat straw in the field every few for fertilizing purposes (likely every 3 years). This trend can increase the annual variation of potential wheat straw availability. Dry weather can impact the availability of wheat straw because i) there are lower wheat yields in dry weather, and ii) drier straw which becomes harder to bale, especially when rotary combines are used (which they are in the majority of cases in the BD Zone). Feedstock availability variation can increase due to the length of the harvesting window. If the length of the harvesting window shortens (due to weather), growers will have less time to harvest grain, and less incentive to concern themselves with harvesting wheat straw. Raw RI Score is deemed *high.*	**9**

Notched Salience Score	RI 3.1.5 could be *broadly* mitigated by the large BAM in the BD Zone that provides significant feedstock redundancy, as well as the planned inclusion of >18 months' worth of on-site inventory capacity. There are positive indications for risk mitigation in that the cost of additional transportation is relatively small compared to the total cost of feedstock (see supply curves in Appendix B). For example, at 50 km from Melville the transportation cost makes up 13% of the total cost. This relatively small additional cost due to year-to-year supply variation can be seen in Table 12 of Appendix B, in the 1-in-10 year and 1-in-20-year low columns. As a result, the Raw RI Score is notched by 75%: Notched Salience is 2.25.	**2.25**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 22.50 out of 100.	**22.50**

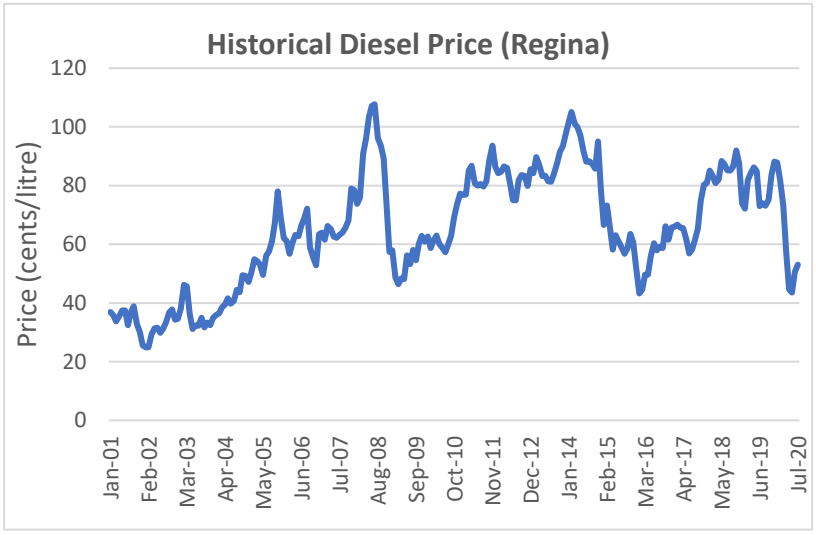
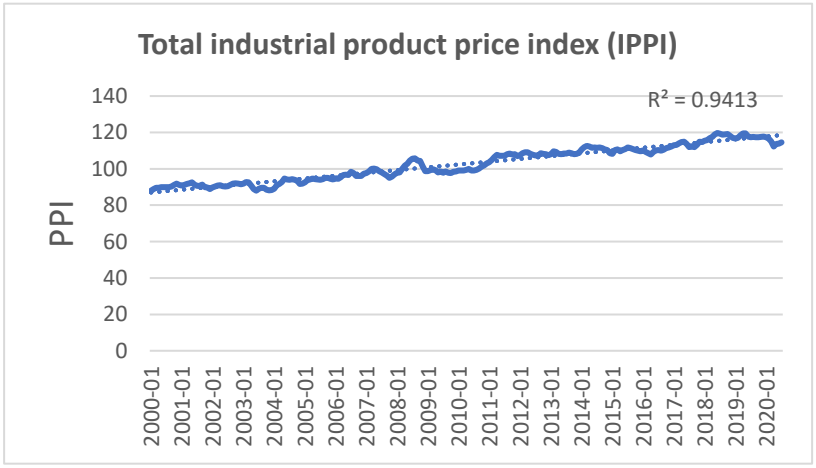
Risk Indicator 3.1.6	**Double-Counting Feedstock**	**Score**
Reporting Requirements / Recommendations	RECOMMENDATION: 1. Sources of feedstock for brokers, intermediaries or aggregators should be disclosed.	
Raw RI Score	All feedstock availability estimates are based on feedstock directly available from growers. While estimates are approximate, here is no double-counting risk in our method. Raw RI Score is deemed *low.*	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 9.99 out of 100.	**9.99**

Risk Indicator 3.1.7	**Front-End Validation of Data Used in Feedstock Availability Models**	**Score**
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Data behind feedstock supply models shall be transparent and credible. 2. Samples of data underlying feedstock supply models shall be verified. RECOMMENDATIONS: 1. If possible, alternative data sources should be considered to validate primary data used in model estimates.	
Raw RI Score	All assumptions used in the development of feedstock supply curves are provided in Appendix B of this rating. Assumptions are based on verbal feedback from multiple local growers in the BD Zone. These assumptions were validated through other theoretical approaches, such as the BIMAT model. Raw RI Score is deemed *low.*	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 9.99 out of 100.	**9.99**

Risk Indicator 3.2.1	Historical Feedstock Price Variations and "Red-Line" Feedstock Cost	Score
Reporting Requirements / Recommendations	REQUIREMENTS: Proponent shall: 1. Identify drivers of historical feedstock price variations. 2. Assess probability and impact of price drivers occurring in the future, and their impact on feedstock availability and price. 3. Compare their red-line feedstock cost with historical maximums and describe mitigation measures, if required.	
Raw RI Score	There is little historical price data available for wheat straw. Price projections are based on growers' verbal indications and ask prices. Lack of widespread experience in wheat straw harvest and baling may cause growers to underestimate actual cost. What limited demand for wheat straw currently exists comes from cattle feedlots; however, the available supply greatly exceeds demand (estimated 2.5% of generated wheat straw goes to feed). Prices estimated in Appendix B of this report are based on growers' verbal feedback which is based on current low market demand. Increased demand may drive price. Wheat straw price drivers include: demand, cost of harvest, baling and transportation. Cost of baling and transportation may also increase over time, for example, with increasing diesel prices. For BD Zone designation purposes, there is no red-line cost but rather a series of supply vs. cost curves under various assumptions. Raw RI Score is deemed *moderate/high.*	**7**
Notched Salience	RI 3.2.1 could be *significantly* mitigated by fixed-price contracts or a pricing strategy that would incentivize growers to supply at a fixed price; for example, by sharing profits on the product sales side. We believe that the large BAM and the nominal impact on delivered cost of wheat straw of transport distance outside the BD Zone will function to stabilize future price fluctuations of wheat straw. As a result, the Raw RI Score is notched by 50%: Notched Salience is 3.5.	**3.5**
Impact Level	RI Impact Level is deemed *low*.	**3.33**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 11.66 out of 100.	**11.66**

Risk Indicator 3.2.2	Low Historical Demand for Feedstock in the Supply Basin	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Understanding of historical feedstock production in the supply basin shall be demonstrated, including an assessment of the degree of risk presented by feedstock production history and supply expertise. If necessary, mitigation strategies shall be demonstrated.	
Raw RI Score	The supply basin has no history of developed, large-scale wheat straw consumers. Therefore, suppliers do not have expertise in feedstock production, which poses a significant risk of unreliable supply. Raw RI Score is deemed *high.*	**9**
Notched Salience	RI 3.2.2 could be *significantly* mitigated by outsourcing harvest and collection to a credible third-party baling company or by provision of similar services through a vertically integrated bio-project. As a result, the Raw RI Score is notched by 50%: Notched Salience is 4.5.	**4.5**
Impact Level	RI Impact Level is deemed *low*.	**3.33**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 14.99 out of 100.	**14.99**

Risk Indicator 3.2.3	History of Production / Feedstock is a Secondary Crop or a By-Product	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Proponent shall determine primary product/crop production levels that are necessary to sustain feedstock production. 2. Proponent shall demonstrate understanding of the market drivers for primary product on which by-products or secondary feedstock depends.	
Raw RI Score	There is no history of producing wheat straw on a large scale in the BD Zone. Feedstock is a by-product of wheat production. The ratio of wheat to wheat straw production is linear. Potential wheat straw availability depends on the number of wheat acres planted, the weather and the type of wheat. The number of wheat acres planted each year partly depends on crop prices. If growers feel that wheat prices will be low and other crop prices high (growers often make planting decisions a few months before seeding), they will plant less wheat and more of other crops. Dry weather affects the potential availability of wheat straw because i) there are lower wheat yields in dry weather, and ii) drier straw which becomes harder to bale, especially when rotary combines are used (which they are in the majority of cases in the BD Zone). Raw RI Score is deemed *high.*	**10**
Notched Salience	RI 3.2.3 could be *broadly* mitigated by the large BAM and relatively flat supply curve. The cost of additional transportation is relatively small compared to the total cost of feedstock. As a result, the Raw RI Score is notched by 75%: Notched Salience is 2.5.	**2.5**
Impact Level	RI Impact Level is deemed *low*.	**3.33**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 8.33 out of 100.	**8.33**

Risk Indicator 3.3.1	Diesel, Oil and Producer Price Index (PPI)	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Feedstock price risk relating to diesel/oil cost and PPI fluctuations and its impact on the Proponent shall be evaluated for a 10-year period.	
Raw RI Score	Diesel/oil price and the Producer Price Index (PPI) affect the delivered cost of wheat straw. Diesel price affects baling and transportation cost directly. The PPI index affects baling and transportation costs indirectly, through labour costs. The figure below shows historical diesel prices in Regina, SK, for the past 10 years. Diesel price volatility is apparent. On the other hand, the industrial product price index (IPPI) experiences little year-to-year volatility, with a constant increase. Raw RI Score is deemed *low.*   	**2**
Notched Salience	No adjustments.	**2**
Impact Level	RI Impact Level is deemed *low*.	**3.33**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 6.66 out of 100.	**6.66**

Risk Indicator 3.3.2	Currency Risk	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Proportion of Proponent feedstock which is sourced cross-border shall be identified by quantity and cost. 2. Cross-border suppliers of particular importance shall be identified. 3. The impact of reasonable exchange fluctuations on feedstock cost shall be assessed for at least a 10-year period.	
Raw RI Score	None of the feedstock would be sourced from across the border, and therefore there is no currency risk. Raw RI Score is deemed *low.*	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed *low*.	**3.33**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 3.33 out of 100.	**3.33**

Risk Indicator 3.3.3	Border Risk	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Proportion of Proponent feedstock which is sourced cross-border shall be identified by quantity and cost. 2. Cross-border suppliers of particular importance shall be identified. 3. The impact of border delays/shutdown on feedstock cost shall be assessed for at least a 10-year period.	
Raw RI Score	None of the feedstock would be sourced from the US, therefore there is no border risk. Raw RI Score is deemed *low.*	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed *low*.	**3.33**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 3.33 out of 100.	**3.33**

Risk Indicator 3.3.4	Temporary Externality-Driven Markets for Feedstock	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Any alternative, non-traditional and externality-driven markets for feedstock shall be identified, and the likelihood of impact of these markets upon the Proponent shall be assessed.	
Raw RI Score	No non-traditional and externality-driven markets for feedstock were identified. Raw RI Score is deemed *low.*	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed *low*.	**3.33**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 3.33 out of 100.	**3.33**

Risk Indicator 3.4.1	Harvest and Collection Practices and Schedules	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Understanding of feedstock harvest practices and schedules shall be demonstrated. 2. Understanding of weather risk and its impact on feedstock quantity and quality in relation to harvesting schedules shall be demonstrated. 3. Understanding of any potential public backlash to harvest practices shall be demonstrated. RECOMMENDATIONS: 1. Typical harvesting schedule and Proponent's planned delivery schedule for feedstock should be prepared.	
Raw RI Score	Wheat is harvested between late August and early October. There is a four-week spread in harvesting between the southern and northern areas of the supply basin. Harvesting window may shorten due to weather. Wheat straw has to be baled and transported immediately after harvest. Growers indicated that they would not tolerate wheat straw laying in bales in the fields. Dry weather can have a detrimental effect on feedstock quality and quantity. Firstly, dry weather can negatively affect wheat yields, leading to lower quantities of generated wheat straw. Secondly, dry weather can dry out wheat straw to a point where it becomes difficult to bale. This is especially the case when rotary combines are used, thus compounding the impact of dry weather. No public backlash against feedstock production, collection and delivery is anticipated. Raw RI Score is deemed *moderate/high.*	**7**
Notched Salience	RI 3.4.1 could be *significantly* mitigated by the involvement of an experienced third-party baling company (or by provision of similar services through a vertically integrated bio-project). Such a company could utilize square balers, which can handle the output of rotary-type combines. It would also mitigate the risk of shorter harvesting windows, as it would put all its efforts into baling in a timely manner. As a result, the Raw RI Score is notched by 50%: Notched Salience is 3.5.	**3.5**
Impact Level	RI Impact Level is deemed moderate.	**6.66**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 23.31 out of 100.	**23.31**

Risk Indicator 3.4.2	Harvesting and Collection Equipment	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Understanding of equipment requirements to produce high-quality feedstock shall be demonstrated, including all equipment typically used for harvesting, collection and processing. 2. Understanding of equipment variety in the supply chain, and its impact on feedstock quality consistency shall be demonstrated.	
Raw RI Score	In terms of yield, the optimal type of combine for harvesting wheat straw is the conventional combine. Conventional combines produce wheat straw of relatively long lengths which is easier for balers to collect. Rotary combines are a common alternative and produce more wheat than conventional combines, but cut the straw into shorter lengths that is more difficult to bale. It is primarily for this reason that the vast majority of wheat growers in the BD Zone use rotary combines; conventional combines tend to be used only by wheat growers who also raise cattle and collect straw for bedding and feed. The rotary combine is a newer type of harvest equipment that maximizes grain separation, but at the expense of straw length: the separation process has a tendency to shred straw to lengths significantly smaller than the conventional combine. This is problematic for collection of wheat straw as round balers have difficulty baling the short straw lengths that are produced by rotary combines. Square balers have no issue with handling short straw lengths but are uncommon in the BD Zone. We note anecdotal information which suggests that at least some rotary combines have a switch enabling the production of longer straw. Raw RI Score is deemed *high* because harvesting and collection equipment most widely used in the supply basin is not designed for collecting / baling wheat straw on a large-scale.	**10**
Notched Salience	Given the large capital cost investment, and loss of primary crop yield, the likelihood of growers purchasing conventional balers is low. For the same reasons, there is a low likelihood of mass investment by local growers in square baler to supply a bio-plant in the BD Zone. RI 3.4.2 could be *significantly* mitigated by outsourcing harvest and collection to a credible third-party baling company which can supply square balers or by provision of similar services through a vertically integrated bio-project. As a result, the Raw RI Score is notched by 50%: Notched Salience is 5.	**5**
Impact Level	RI Impact Level is deemed moderate.	**6.66**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 33.30 out of 100.	**33.30**

Risk Indicator 3.4.3	Variation in Densification Methods Among Different Suppliers	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Understanding of the impacts of different modes of feedstock densification shall be demonstrated.	
Raw RI Score	The vast majority of balers available in the supply basin are round balers. If growers were to invest in square balers (which is deemed unlikely due to capital cost), the resulting mix of round and square bales can create less homogeneous feedstock supply for a bio-project including high variations in MC and issues with handling and processing equipment. In addition, round bales cost more to transport on a per ton basis than square bales, however the impact of this is only somewhat significant. Raw RI Score is deemed *moderate.*	**5**
Notched Salience	RI 3.4.3 could be *significantly* mitigated by outsourcing harvest and collection to a credible third-party baling company which can supply square balers and ensure homogenous bale density and size, or by provision of similar services through a vertically integrated bio-project. As a result, the Raw RI Score is notched by 50%: Notched Salience is 2.5.	**2.5**
Impact Level	RI Impact Level is deemed moderate.	**6.66**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 16.65 out of 100.	**16.65**

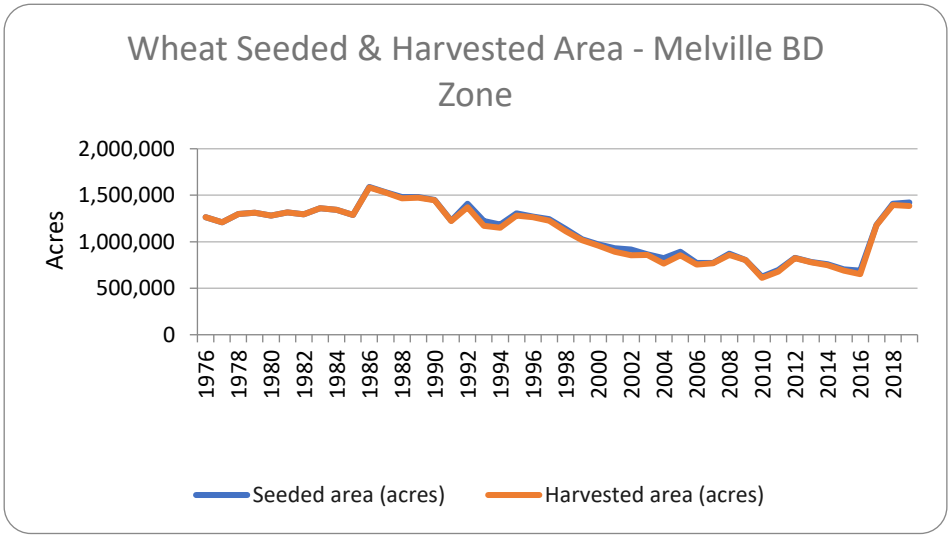
Risk Indicator 3.4.4	Availability of Labour for Feedstock Production	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Understanding of labour requirements necessary to produce and deliver feedstock shall be demonstrated, including: a) Number of trained operators of field equipment, b) Number of harvesters, c) Experience of existing labour force, d) Necessary laborer certifications.	
Raw RI Score	Labour for wheat straw collection and transportation is needed only for 4-6 weeks of the year during harvest. We deem it likely that transport companies will be able to handle temporarily increased demand as this is a common dynamic in agricultural markets: trucks could be brought in from other provinces and states if need be. We find the capacity of the existing labour forces to respond to the additional demand for baling of moderate concern. Firstly, partly due to farm consolidation that resulted in lower labour needs, the Melville region lost between 38% and 54% of its population; however, since that time, population rates have been increasing at a projected rate of 0.35-0.50% per year (DG Mercer Eco Research, 2019). The lack of trained baler operators poses a more immediate risk. The number of trained baler operators is low; understandably, due to a current lack of markets for wheat straw and an underdeveloped supply chain. As a result, willing individuals would need to be trained. This may be complicated by the relatively short harvesting season (less time to train new baler operators). Raw RI Score is deemed *moderate/high.*	**7**
Notched Salience	RI 3.4.3 can be *significantly* mitigated by importing temporary labor and trucking equipment from other regions. In addition, all sub-risks in RI 3.4.4 could be significantly mitigated by outsourcing harvest and collection to a credible third-party baling company or by provision of similar services through a vertically integrated bio-project. As a result, the Raw RI Score is notched by 50%: Notched Salience is 3.5.	**3.5**
Impact Level	RI Impact Level is deemed moderate.	**6.66**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 23.31 out of 100.	**23.31**

Risk Indicator 3.5.1	Feedstock Transportation Costs	Score
Reporting Requirements / Recommendations	REQUIREMENTS: Proponent shall demonstrate understanding of: 1. Average transportation cost per-unit of delivered material. 2. The percentage of total (current and projected) feedstock cost attributable to transport. 3. Feedstock cost in relation to transportation cost drivers via a sensitivity analysis. 4. Forecasted transportation. RECOMMENDATION: 1. Mitigation plan for escalating transportation costs should be demonstrated.	
Raw RI Score	We estimate that transportation costs constitute 10% -15% of the total feedstock delivered cost. We note that a relatively minor increase in average transport distance yields a very significant expansion of the feedstock supply basin (see supply curves). We therefore assess the risk of increasing transportation costs significantly affecting the delivered price of feedstock as *low*. In the interests of not prejudicing future negotiations between markets and growers, detailed transport calculations are not including in this rating. Raw RI Score is deemed low/*moderate*	**3**
Notched Salience	No adjustments.	**3**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 30.00 out of 100.	**30.00**

Risk Indicator 3.6.1	Number, Size Mix and Locations of Suppliers	Score
Reporting Requirements / Recommendations	REQUIREMENTS: Proponent shall demonstrate understanding of: 1. Minimum number of feedstock suppliers required to minimize feedstock supply risk. 2. Maximum proportion of Proponent's total feedstock requirement that one supplier controls. 3. Optimal number of small and large suppliers in the supply chain. 4. Impact of geographic locations of suppliers (i.e., supplier density) on supply chain resilience.	
Raw RI Score	There is a large number of viable potential suppliers of feedstock in the area. Of growers surveyed, 18 expressed willingness to supply a total of 27,750 ODMT/yr of wheat straw. Based on this sample, approximately 150 to 250 growers would be needed to support a large-scale project. A large number of suppliers can decrease feedstock risk because a breach of a few suppliers would not significantly affect the entire supply chain. On the other hand, feedstock supply chains of this size can be more challenging to coordinate. Raw RI Score is deemed *moderate.*	**5**
Notched Salience	The large number of potential suppliers can make use of the third-party baling company (or provision of baling services by the off-taker) more complicated and potentially more costly. Because RI 3.6.1 dampens the effectiveness of the introduction of a third-party baling company as a mitigant to other RIs, the Raw RI Score is negatively notched by 125%: Notched Salience is 7.5.	**7.5**
Impact Level	RI Impact Level is deemed high.	**6.66**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 49.95 out of 100.	**49.95**

Risk Indicator 3.6.2	Suppliers Subject to Same External Risk Factors (non-weather and equipment based)	Score
Reporting Requirements / Recommendations	REQUIREMENTS: Proponent shall demonstrate understanding of: 1. The set of common risks that impact over 75% of suppliers in the supply chain (not including weather and equipment impacts). 2. Factors that mitigate the set of common risks, including: a) Spatial location (i.e., degree to which suppliers are clustered together), b) Soil composition (i.e., drainage profile), c) Supply chain structure, d) Regulatory impacts. 3. Proportion of suppliers and supply that are subject to the same external risk factors. 4. Maintenance of suitably sized inventory piles and pre-arrangements for redundant feedstock with non-local suppliers where a high proportion of supply is subject to the same external risk factors.	
Raw RI Score	Wheat straw suppliers are subjected to risks related to decreasing wheat prices which could cause growers to replace wheat with other crops. Raw RI Score is deemed *high.*	**9**
Notched Salience	RI 3.6.2 could be *significantly* mitigated by expanding the radius of the supply basin. Supply curves indicate widespread availability at marginal increased cost. On-site bale inventories of >18 months can mitigate typical moderate fluctuations in straw supply. As a result, the Raw RI Score is notched by 50%: Notched Salience is 4.5.	**4.5**
Impact Level	RI Impact Level is deemed moderate.	**6.66**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 29.97 out of 100.	**29.97**

Risk Indicator 3.6.3	Land Ownership Structures	Score
Reporting Requirements / Recommendations	REQUIREMENTS: Proponent shall demonstrate understanding of: 1. Land ownership structures for the procured feedstock, including ownership/lease terms with growers and any changes in ownership/lease terms. 2. Impact of land ownership/control on overall long-term feedstock risk.	
Raw RI Score	Land is owned by growers. The land ownership structure does not pose a risk to the supply chain.	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed moderate.	**3.33**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 3.33 out of 100.	**3.33**

Risk Indicator 3.7.1	Seasonal Weather Impacts on Feedstock Supply	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Understanding of weather patterns in the supply basin and their potential impacts to feedstock production shall be demonstrated. 2. Where high risk of feedstock shortage due to seasonal weather exists, a mitigation plan shall be demonstrated. RECOMMENDATIONS: 1. Forecasting and propagation models should be applied in analyses of weather impacts.	
Raw RI Score	Weather can have a significant impact on feedstock supply. Wheat production, and therefore potential wheat straw availability, varies from year-to-year. Weather events (among other factors) may cause significant variances in yield but the range of variance has been well tracked: 1-in-10 and 1-in-20-year low statistics are published (BIMAT). In a 1-in-10-year low year, potential wheat straw availability is 61% of an average year's availability within 10 km of Melville; in a 1-in-20 year low year, it is 53%.  When it is dry, wheat straw can be too dry for baling (especially with rotary combines which are common in the BD Zone) and lower wheat yields. Early onset of winter can shorten the harvesting season, leaving less time for wheat straw collection (growers prioritize grain over collection of wheat straw). Raw RI Score is deemed *moderate/high.*	**7**
Notched Salience	RI 3.7.1 could be *significantly* mitigated by the region's large BAM; marginal increased cost related to longer transport distances; on-site bale inventories of >18 months; option agreements with redundant growers; and engagement of a credible third-party (or equivalent vertical integration of such service within a bioproject) to harvest / bale wheat straw from redundant growers. As a result, the Raw RI Score is notched by 50%: Notched Salience is 3.5.	**3.5**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 35.00 out of 100.	**35.00**

Risk Indicator 3.7.2	Long-Term Weather and Climate Trends	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Assessment of impact of future weather patterns or climactic changes on feedstock availability and price shall be demonstrated. 2. Where risk of changing weather patterns and/or climatic trends and their detrimental impact to feedstock availability is significant, a mitigation plan shall be demonstrated.	
Raw RI Score	Although definitive forecasting is impossible, regional temperatures are likely to rise due to climate change. Drier weather would pose the same risks as in 3.7.1. Raw RI Score is deemed *moderate.*	**5**
Notched Salience	No adjustments.	**5**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 50.00 out of 100.	**50.00**

Risk Indicator 3.7.4	Risk of Infestation	Score
Reporting Requirements / Recommendations	REQUIREMENTS: Infestation of agricultural croplands is dependent on multiple factors, including: biology of pest species; ecology of agricultural sites; suitability of the crops of interest as a sustainable habitat for the pest; and the ability of the pest species to colonize and grow as an invasive species in competition with pre-existing species. 1. Historical occurrences of infestation of Proponent feedstock shall be understood along with vectors through which infestation have historically occurred. 2. Future risk and impact of infestation shall be assessed.	
Raw RI Score	RI 3.7.4 would be heightened by use of a third-party baler: improper sanitization of equipment can transfer disease between fields. There have been no confirmed cases of club root disease in the Melville BD Zone. The pathogen has been detected ~50 km north of the city of Melville, but no symptomatic infections have been confirmed. Most diseases can be contained with proper management. Raw RI Score is deemed *low.*	**2.5**
Notched Salience	No adjustments.	**2.5**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 25.00 out of 100.	**25.00**

Risk Indicator 3.7.5-9	Risk of Extreme Weather Events-- Risk of hail, flood, drought, hurricanes, tornadoes, and strong winds, and extreme low temperature	Score
Reporting Requirements / Recommendations	See BSCRS Standards RI 3.7.5 Risk of Hail; 3.7.6 Risk of Flood; 3.7.7 Risk of Drought; 3.7.8 Risk of Hurricanes, Tornadoes, Strong Winds; 3.9.7 Risk of Low Temperatures	
Raw RI Score	Extreme weather events such has hail, flooding and strong winds pose a limited risk to wheat straw availability in the Melville BD Zone. Raw RI Score is deemed *low.*	**2.5**
Notched Salience	No adjustments.	**2.5**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 25.00 out of 100.	**25.00**

Risk Indicator 3.8.1	Government Subsidies for Feedstock Production or Utilization	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Proponent shall indicate any government subsidies that directly relate to feedstock. 2. Proponent shall estimate the likelihood and impact of removal of such subsidies on feedstock supply. RECOMMENDATIONS: 1. In case of existing feedstock subsidies, an alternative to the subsidized feedstock should exist.	
Raw RI Score	At this point there are not government subsidies with respect to feedstock. Neither does production of wheat rely on government subsidies. Raw RI Score is deemed *low*.	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed *low*.	**3.33**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 3.33 out of 100.	**3.33**

Risk Indicator 3.8.2	Local, Provincial, and National Laws, Regulations and Permitting Pertaining to Biomass	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Proponent shall indicate direct feedstock supply dependencies on laws, regulations or permits. 2. Proponent shall assess the likelihood and impact of change of such laws, regulations on feedstock supply, including those related to: forest harvesting; air quality/emissions; land-use change regulations; traffic, noise, odor, dust; and wildlife protection. 3. Proponent shall assess the likelihood of obtaining necessary permits.	
Raw RI Score	Wheat straw supply does not depend on any government laws, regulations or permits. No changes in these laws, regulations or permits with respect to wheat straw is expected. Raw RI Score is deemed *low*.	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed *low*.	**3.33**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 3.33 out of 100.	**3.33**

Risk Indicator 3.8.3	Backlash Against Biomass Development, Procurement or Usage in the Region	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Likelihood of potential backlash against biomass development in the region shall be assessed. RECOMMENDATIONS: 1. In case of likely potential backlash against biomass development, a mitigation and communications plan should be developed in conjunction with the local community.	
Raw RI Score	No backlash against biomass development is expected. Raw RI Score is deemed *low*.	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed *low*.	**3.33**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 3.33 out of 100.	**3.33**

Risk Indicator 3.8.4	Consent of, and Co-Operation With, Indigenous Communities and First Nations	Score
Reporting Requirements / Recommendations	REQUIREMENTS: 1. Proponent shall demonstrate an understanding of any potential conflicts it may encounter with Indigenous land rights or First Nation communities. RECOMMENDATIONS: 1. In cases where feedstock is procured from Indigenous lands, or where Indigenous communities exert influence over lands, the project should ensure that the Indigenous community has been consulted and have expressed consent.	
Raw RI Score	No Indigenous communities were identified that would be affected by wheat straw production or procurement in the supply basin. Raw RI Score is deemed *low.*	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed *low*.	**3.33**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 3.33 out of 100.	**3.33**

Risk Indicator 3.9.1	Feedstock Sustainability, Including risks to soil quality and surface and groundwaters.	Score
Reporting Requirements / Recommendations	REQUIREMENT: 1. Understanding of biomass feedstock sustainability shall be demonstrated.	
Raw RI Score	The vast majority of wheat straw is currently left in the field as a fertilizer. Removal of significant quantities would require fertilizer replacement. Perceived impact on soil quality of wheat straw removal may impact participation: not all suppliers will agree to wheat straw removal. Even growers that agree to supply need to leave wheat straw in the field approximately every 3 years. Raw RI Score is deemed *moderate.*	**5**
Notched Salience	RI 3.9.1 could be *significantly* mitigated through the use of fertilizer as a replacement for the wheat straw that otherwise would have remained in the fields, but is instead being removed for utilization as bio-project feedstock. As a result, the Raw RI Score is notched by 50%: Notched Salience is 2.5.	**2.5**
Impact Level	RI Impact Level is deemed *low*.	**3.33**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 8.33 out of 100.	**8.33**

Risk Indicator 4.1.5	Geographic Location Influence on Feedstock Variability	Score
Reporting Requirements / Recommendations	REQUIREMENT: 1. Proponent shall demonstrate understanding of geographic regions from which feedstock will be sourced, and any effect on feedstock quality.	
Raw RI Score	Significant variation in feedstock quality is not expected from feedstock harvested within the BD Zone. Raw RI Score is deemed *low*.	**1**
Notched Salience	No adjustments.	**1**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 9.99 out of 100.	**9.99**

Risk Indicator 5.1.2	Capacity of Supply Chain Components and Equipment to scale	Score
Reporting Requirements / Recommendations	REQUIREMENTS: Proponent shall demonstrate that: 1. Throughput rates and efficiencies of each supply chain component are adequate for proposed plant scale. 2. Necessary underlying infrastructure component capacities are adequate for proposed plant scale. RECOMMENDATION: 1. The plant size and design should be optimized with the feedstock availability.	
Raw RI Score	There is more than sufficient wheat straw generated to support a large-scale project (see feedstock supply curves). However, baling equipment in the supply basin is insufficient to support a large-scale project, especially in the short-term. We find the prevalence of round balers in combination with rotary combines to be a high risk: round balers are ineffective for baling straw processed by rotary combines. Given the large number of growers that are required to generate up to 300,000 ODMT, it is unlikely that enough individual growers would invest in more efficient baling equipment. It is clear that it is unrealistic to expect growers to change combine-type, as the economic incentive or any market for wheat straw is insufficient. There is a high risk that baling equipment would not scale, especially in the short-term. Labour availability may be an issue as well, as discussed above. Raw RI Score is deemed *high.*	**10**
Notched Salience	RI 5.1.2 could be *moderately* mitigated by outsourcing harvest and collection to a credible third-party baling company, or by provision of similar services through a vertically integrated bio-project. As a result, the Raw RI Score is notched by 25%: Notched Salience is 7.5	**7.5**
Impact Level	RI Impact Level is deemed high.	**9.99**
Loaded RI Score	Loaded Risk score (Notched Salience x Impact Level) is 75.00 out of 100.	**75.00**

APPENDIX B: BD Zone Designation

This appendix serves as a wheat straw availability background study to the BD Zone Risk Rating for the City of Melville, SK.

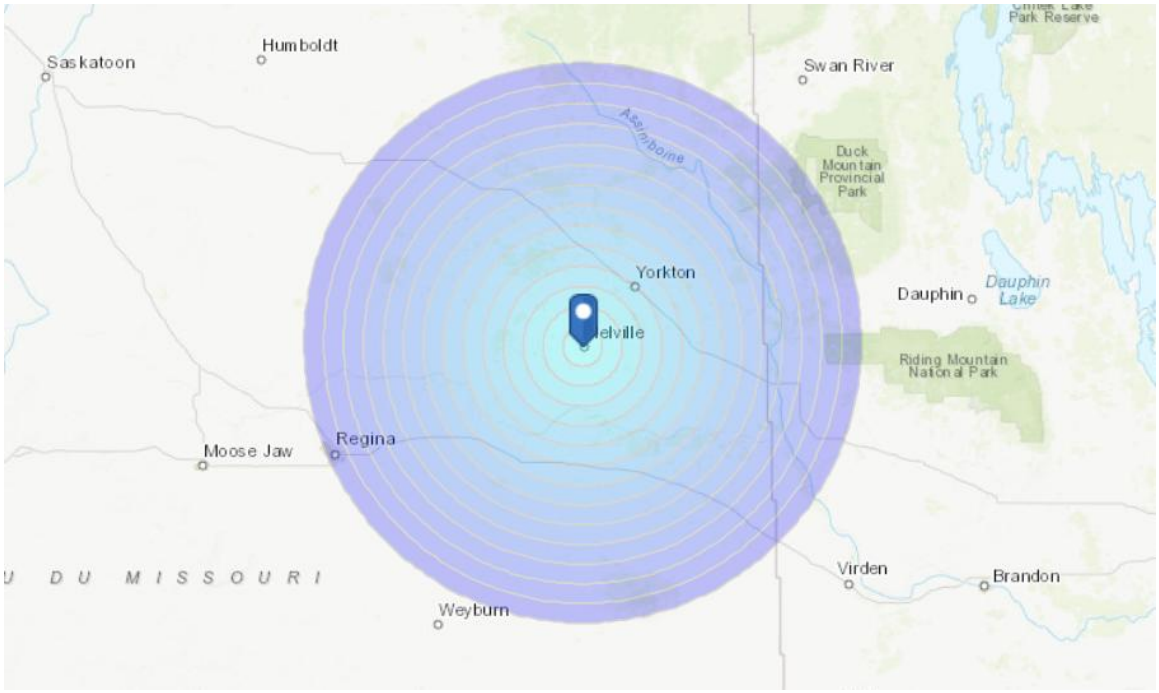
BACKGROUND RESEARCH AND ASSUMPTIONS

BD Zone Supply Basin

The supply basin is the area around surrounding Melville, SK, within which wheat straw can be sourced in accordance with the quantity, cost and risk level parameters outlined by this BD Zone Risk Rating. For analysis purposes, a region within 140 km from Melville in 10 km intervals was investigated (Map 1).

The competition zone is defined by a distance double that of the supply basin: 280 km from Melville, SK.

Map 1: Feedstock supply basin of 140 km radius by 10 km intervals



Current Demand

Presently, there are no large-scale facilities consuming wheat straw within the 280 km competition zone surrounding Melville, SK.

Cattle feedlots are the only significant consumers of wheat straw in the region. Wheat straw is mostly used for bedding, and occasionally for feed. Sokhansanj et al. (2006) estimates that in the Prairie provinces, 2.5% of generated wheat straw goes to cattle feedlots.[4] To keep regional estimates of wheat straw availability conservative, *double this estimate (i.e., 5%) is used in all of the following calculations*.

Due to the lack of significant markets for wheat straw, it is estimated that 95% of all wheat straw is left in the fields.

Historical demand

One large-scale regional wheat straw project was identified to have closed in 2005. The Dow BioProducts strawboard plant in Elie, MB (417 km east of Melville) first became operational in 1998 (owned by Isobord Enterprises at the time). After a shut down in 2001 it was purchased by Dow, which operated it until 2005. The plant spawned the creation of the Straw Producers Co-operative, a group of area growers who had been contracted to supply wheat straw to the plant. This facility sourced feedstock in square bales.

Supply research and assumptions

Potential Wheat Straw Availability

Two approaches were used to determine the potential availability of wheat straw in the region. Potential wheat straw availability refers to the amount of wheat straw that could theoretically be acquired from within the supply basin. It does not consider the availability of equipment or other variables related to infrastructure that could affect actual feedstock availability.

Approach 1: Theoretical model

To estimate the theoretical availability of wheat straw, Agriculture and Agri-Food Canada's Biomass Inventory Mapping and Analysis Tool (BIMAT) was used to assess each 10 km radius interval from Melville.[5] Since BIMAT only provides data up until 2016 (based on data collected between 1985 and 2016), additional data from Statistics Canada were acquired and BIMAT assumptions were extrapolated onto data for 2017 through 2019.

In addition to BIMAT, a separate model to verify BIMAT's assumptions was also developed internally by Ecostrat. The assumptions of that model are as follows:

- Total wheat straw that could be potentially acquired makes up between 60% and 80% of grain yield by weight.
- Estimates include losses due to chaff and stubbles.[6]
- The average tillage rate is estimated at 8%.[7]

[4] Sokhansanj, S., Mani, S., Stumborg, M., Samson, R., and Fenton, J. (2006). Production and distribution of cereal straw on the Canadian prairies. Canadian Biosystems Engineering, Vol. 48.
https://www.researchgate.net/publication/236999871_Production_and_distribution_of_cereal_straw_on_the_Canadian_prairies
[5] Accessible through: http://www.agr.gc.ca/atlas/bimat
[6] Chaff refers to small particles created through the harvesting process. Stubble refers to the part of the wheat plant that is left in the ground following harvesting.
[7] Tillage refers to the amount of wheat straw tilled back into the ground for soil improvement. The 8% estimate is based on BIMAT estimate for the 80 km supply basin surrounding Melville.

As previously stated, Prairie-wide estimates indicate that 2.5% of generated wheat straw is utilized as cattle bedding and feed. To remain conservative, this estimate was doubled to 5% in all calculations for this report.

Approach 2: Outreach to growers and transport companies

To determine growers' willingness to supply wheat straw, and to confirm wheat straw potential availability assumptions from the first approach described above, phone interviews with 31 growers were conducted.

Growers tended to provide estimates based on per bale and per acre units. For example, the price of wheat straw paid by cattle feedlots is calculated on a per bale basis.

To determine the quantity of wheat straw available per acre, growers were asked for a verbal estimate. In the majority of cases, growers provided a rough estimate of 2 bales per acre at a weight of approximately 0.5 MT per bale. In a few cases divergent estimates were received; for example, estimates of the number of bales yielded per acre varied between wheat straw growers and cattle growers. Select wheat straw growers claimed that as many as 3 - 4 bales per acre could be harvested. On the other hand, cattle growers were generally more conservative, in a few cases claiming that less than 2 bales per acre could be harvested. Table B-1 shows a summary of estimates provided by cattle growers:

Table B-1: Estimates of bales per acre by cattle growers

Bales/acre Estimate	Grower
1.25	Cattle Grower 1
2.00	Cattle Grower 2
1.00	Cattle Grower 3
2.00	Cattle Grower 4
1.56	**Average**

Most growers provided an estimate of 0.5 MT of wheat straw per bale. In a few cases the estimates were higher, as shown in the Table B-2 below:

Table B-2: Estimates of MT per bale (Only estimates that diverged from 0.5 MT/bale are shown)

MT/bale Estimate	Grower
0.65	Grower 1
0.55	Grower 2
0.60	Grower 3
0.55	Grower 4
0.60	Grower 5
0.73	Grower 6
0.61	**Average**

Supply Curve Scenarios

Based on the above assumptions three potential wheat straw availability scenarios were developed:

Expected scenario assumes the rule-of-thumb assumptions quoted by the majority of growers who were spoken with: 2 bales/acre with 0.5 MT/bale.

Upside scenario assumes 2 bales/acre with 0.6125 MT/bale. The 0.6125 MT/bale estimate is an average of estimates provided by growers who did not agree with 0.5 MT/bale estimate.

Downside scenario assumes 1 bale/acre with 0.5 MT/bale. The 1 bale/acre estimate was provided by a custom baler that used to bale for the Dow strawboard processing facility which shut down in 2005. Although this estimate was the most conservative of all estimates gathered, it was applied because the custom baler is the only baler interviewed for this report who has worked for a large-scale wheat straw processing facility in the past.

Participation rate

Potential availability estimates are based primarily on wheat production data. Another important factor to consider however is grower participation rate given that only a portion of growers in the region will be willing to collect and supply wheat straw. Grower participation rate was estimated based on verbal feedback from growers.

In total, 31 growers were surveyed, of which 18 expressed a willingness to supply the wheat straw. Cumulatively, these growers indicated a willingness to supply 27,750 ODMT/yr.

Two estimates for the grower participation rate were derived. Both participation rates are based on the proportion of growers contacted who expressed a willingness to supply feedstock, however each reports on a different metric: i) the first participation rate measures the proportion of individuals expressing interest in supplying out of all growers; ii) the second participation rate measures the proportion of wheat acres these interested individuals manage, as a percentage of the cumulative number of wheat acres that all surveyed growers manage.

i) Out of 31 growers interviewed, 18 expressed a willingness to supply wheat straw, representing 58%.

ii) The 31 growers surveyed cumulatively managed 85,750 acres of wheat. Those 18 growers who expressed interest in supplying cumulatively managed 32,750 acres of wheat straw, representing 38% of the total acreage.

Methodology limitations. There are two main assumptions in this methodology:

1) Growers who verbally indicated willingness to supply will do so (given fair wheat straw prices);
2) Growers who indicated that they are not currently interested in supplying will remain reluctant to supply, even should the price become attractive and the supply chain well developed.

The fact that growers verbally indicated a willingness to supply does not mean they will do so in reality once a project becomes operational. Since a large-scale market for wheat straw does not currently exist, growers may be underestimating the effort it takes to collect and bale wheat straw, as well as underestimating potential issues associated with such collection (e.g., fertilizer replacement or twine left in the field). Therefore, once faced with the reality of collecting and supplying straw, some growers may change their minds and reconsider their willingness to supply.

On the other hand, growers who indicated that they are currently not interested in supplying may reconsider once a project demonstrates that it is a serious buyer and that wheat straw can be a significant source of income for them. Many growers may be skeptical of a project of this nature at first, especially given the history of the failed Dow project in Manitoba. Additionally, growers with negative experiences supplying straw for the cattle bedding market may be initially reluctant to supply any new project as well. This skepticism and reluctance may change once a project demonstrates that it is a reliable and profitable wheat straw off-take market.

As such, risks associated with assumption 1) are likely to be balanced out by assumption 2), resulting in a net positive outcome for a project. Therefore, the estimated grower participation rates of 58% and 38% were maintained for all calculations, recognizing that more research needs to be done to understand the actual availability of wheat straw on-the-ground.

1-in-10 and 1-in-20-year lows

Wheat production, and therefore potential wheat straw availability, varies from year-to-year. 1-in-10 and 1-in-20-year low statistics are available from BIMAT. By determining the percentage of annual potential availability that comprises the 1-in-10 and 1-in-20-year lows, expected lows for each scenario were estimated. For example, BIMAT estimates indicate that during a 1-in-10-year low year, potential wheat straw availability is 61% of an average year's availability within 10 km of Melville, and during a 1-in-20 year low, it is 53%. We then apply these 61% and 53% factors to the *Expected*, *Upside* and *Downside* scenarios.

Wheat Straw Cost

With the exception of a relatively small cattle bedding and feed market (estimated 2.5% of all potential wheat straw production), there is no other market for wheat straw. As a result of this, an understanding of the market price is limited. The bedding and feed markets are scattered and unreliable in their off-take capabilities, and often operate based on a "special deal" basis (e.g., neighbours selling to neighbours at a discounted price). There is no index that tracks the price of wheat straw in the region. For these reasons, market price is estimated based on growers' verbal indications.

Limitations. When interpreting prices verbally indicated by growers, two limitations should be considered:

1) Growers provide "ask" prices. In regular markets, ask prices tend to be higher than the market price as sellers attempt to drive the final price. Therefore, reported ask prices tend to overestimate actual prices.

2) With a high demand, prices can increase significantly. Growers base their price indications on variables such as the cost of replacing straw with fertilizer, the cost of baling, as well as the current market price for bedding and feed straw. Once a large-scale facility significantly increases demand for straw, growers may increase their prices upon realization of a project's need for straw.[8]

[PRICE INDICATIONS PROVIDED BY GROWERS ARE REDACTED]

[8] One way to mitigate price increases due to increased demand is through fixed-price contracts. At this point however, it is unknown whether growers would be open to such agreements.

PROJECTED AVAILABILITY

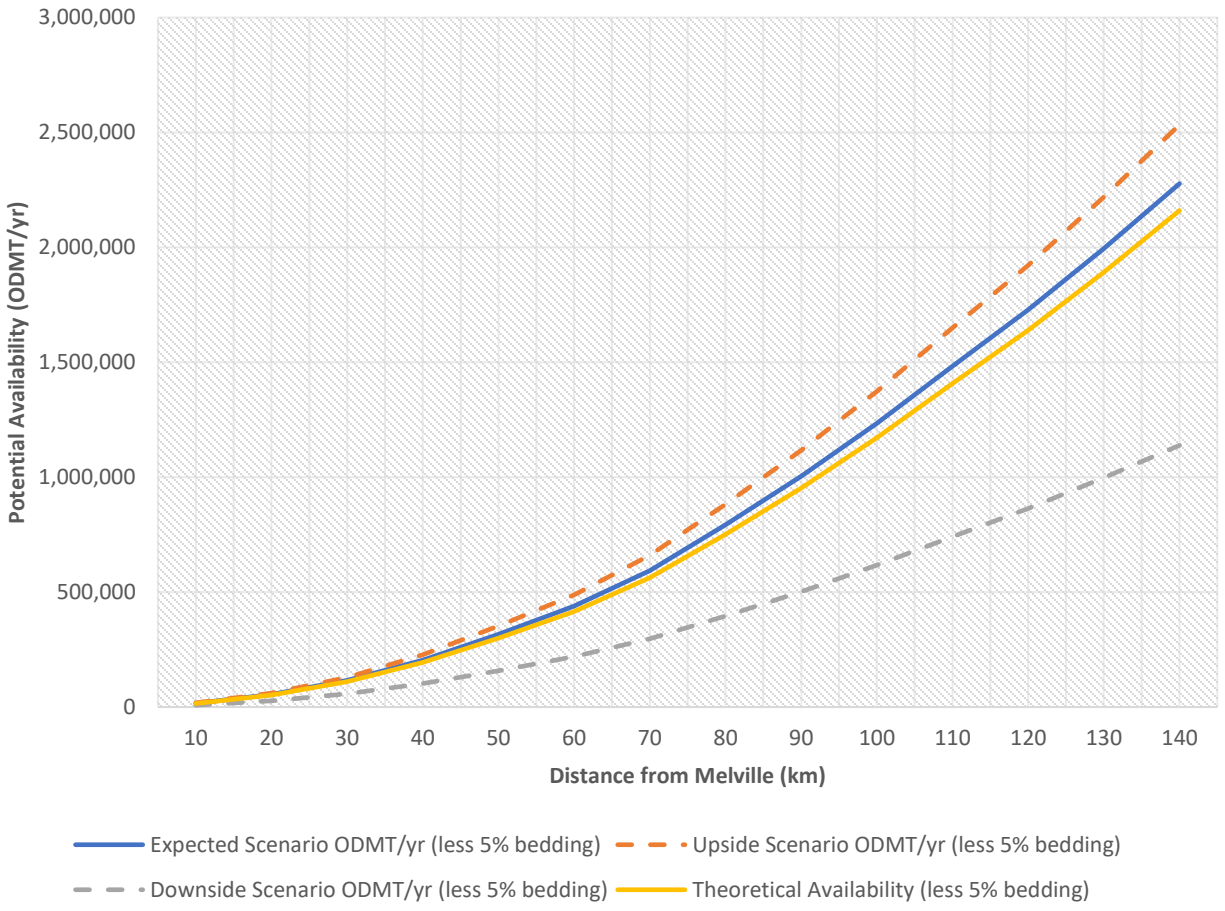
Based on the assumptions outlined above, projected supply curves were developed.

Figure 2 shows potential supply curves plotted against distance from Melville based on the *Theoretical*, *Expected*, *Downside* and *Upside* scenarios. The *Theoretical* scenario is derived from BIMAT and adjusted for recent wheat yield data from Statistics Canada (i.e., Ecostrat's model). The *Expected*, *Downside* and *Upside* scenarios are derived from assumptions based on direct feedback from potential suppliers.

Firstly, note that the *Theoretical* scenario closely follows the *Expected* scenario. In other words, the two methods for deriving projected supply curves verify each other. Consequently, during further analysis the *Expected* scenario was applied as a baseline. The *Upside* and *Downside* scenarios serve as an upper and lower boundary for where the supply could go. In addition to the three scenarios, potential availability based on 1-in-10 and 1-in-20-year wheat yield lows were also projected.

This analysis is based on 58% and 38% participation rate levels, as explained above.

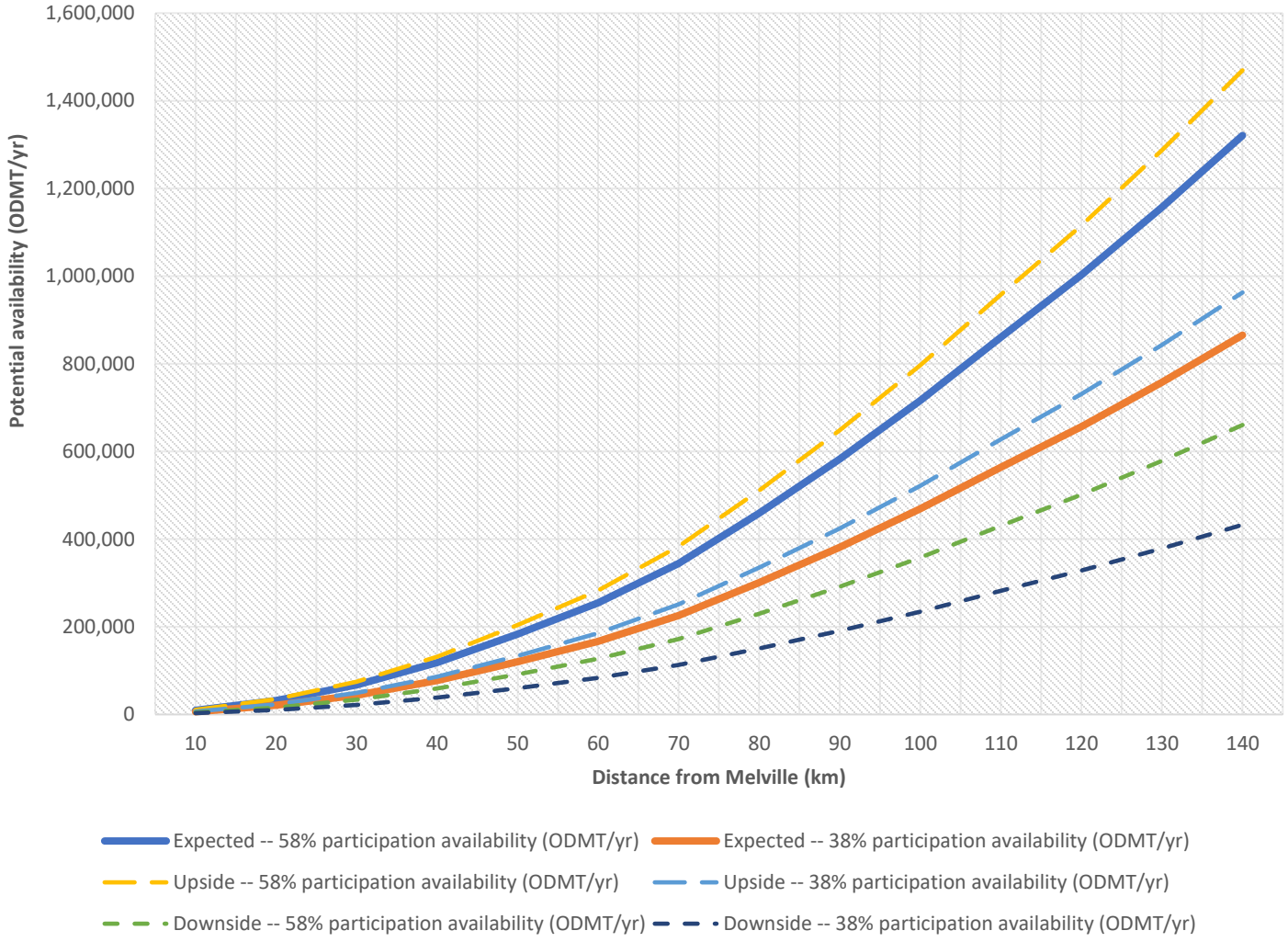
Figure 2: *Theoretical*, *Expected*, *Downside*, and *Upside* scenarios assuming 100% participation rate



Comparison between 58% and 38% participation rates

Figure 3 indicates differences between the 58% and 38% grower participation rates. The two solid-line supply curves represent the *Expected* scenarios. A more detailed analysis under different scenarios is provided in subsequent subsections.

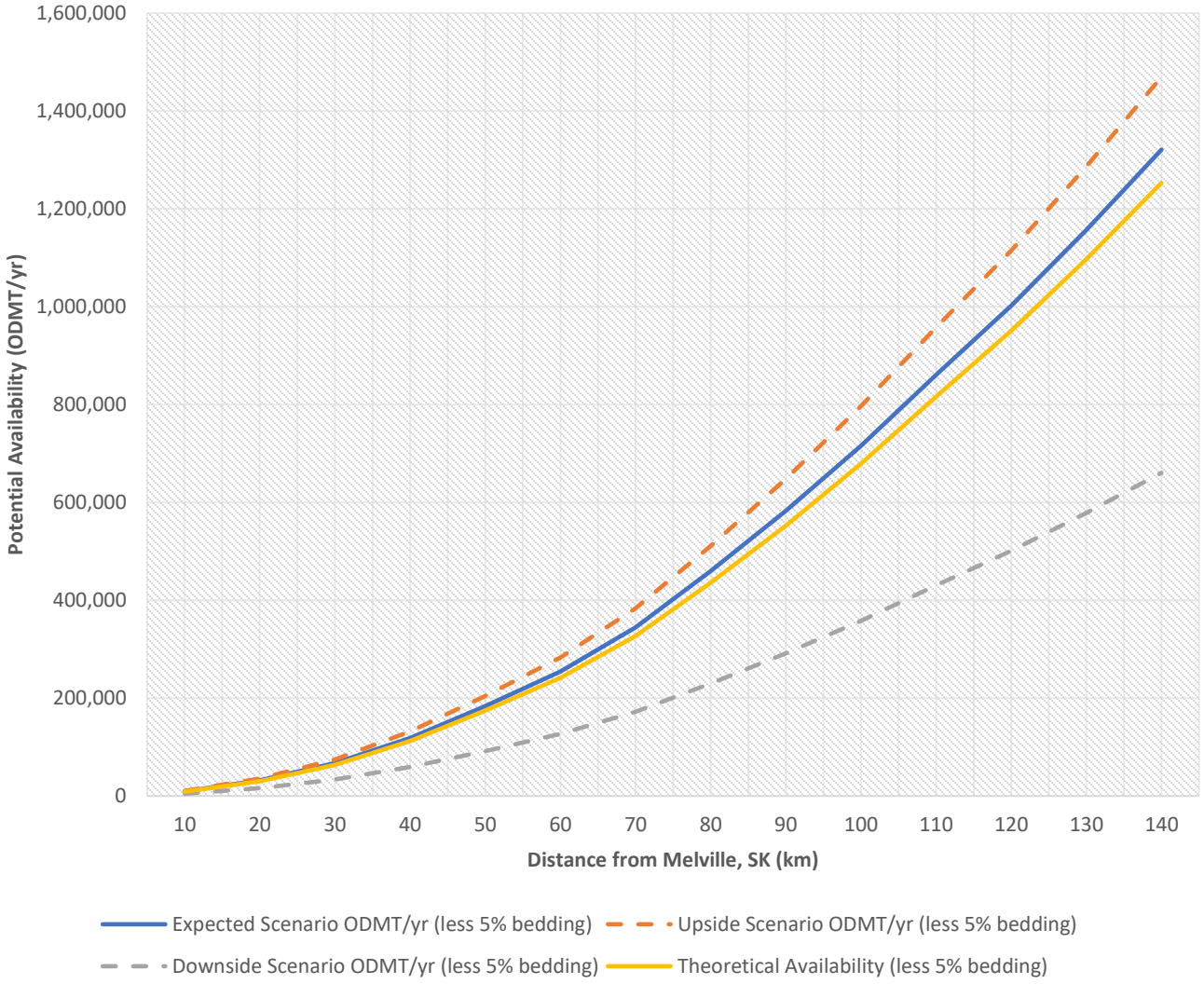
Figure 3:
Summary of all scenarios based on 58% and 38% participation rates



58% participation rate assumption

This subsection provides an analysis of projected feedstock supply and costs based on a 58% grower participation rate assumption. Figure 4 compares supply curves for the *Expected*, *Upside*, and *Downside* scenarios.

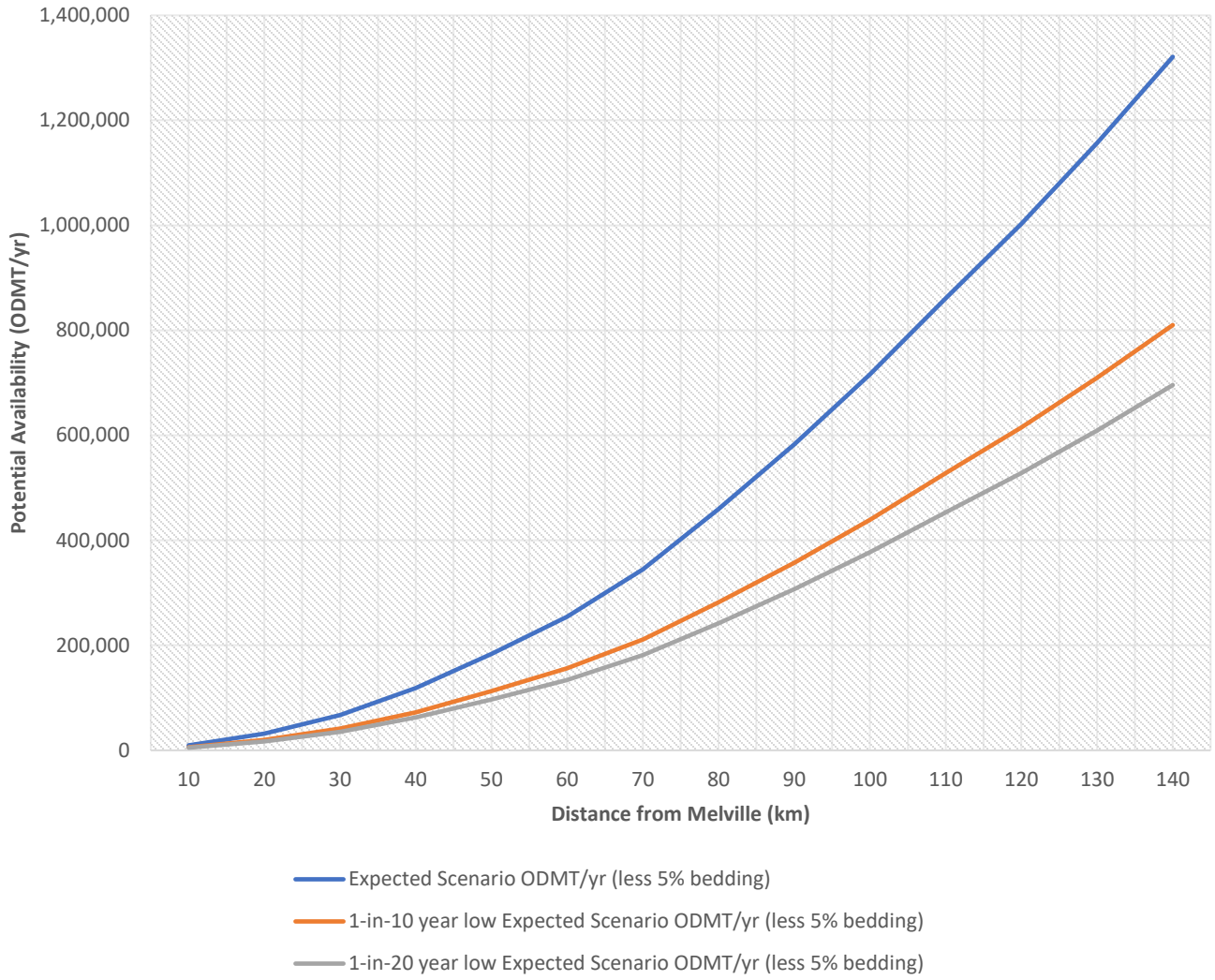
Figure 4: *Expected*, *Downside*, and *Upside* scenarios assuming a 58% participation rate



Expected Scenario assuming a 58% participation rate

Figure 5 indicates projected feedstock availability under the *Expected* scenario, and assuming a 58% participation rate.

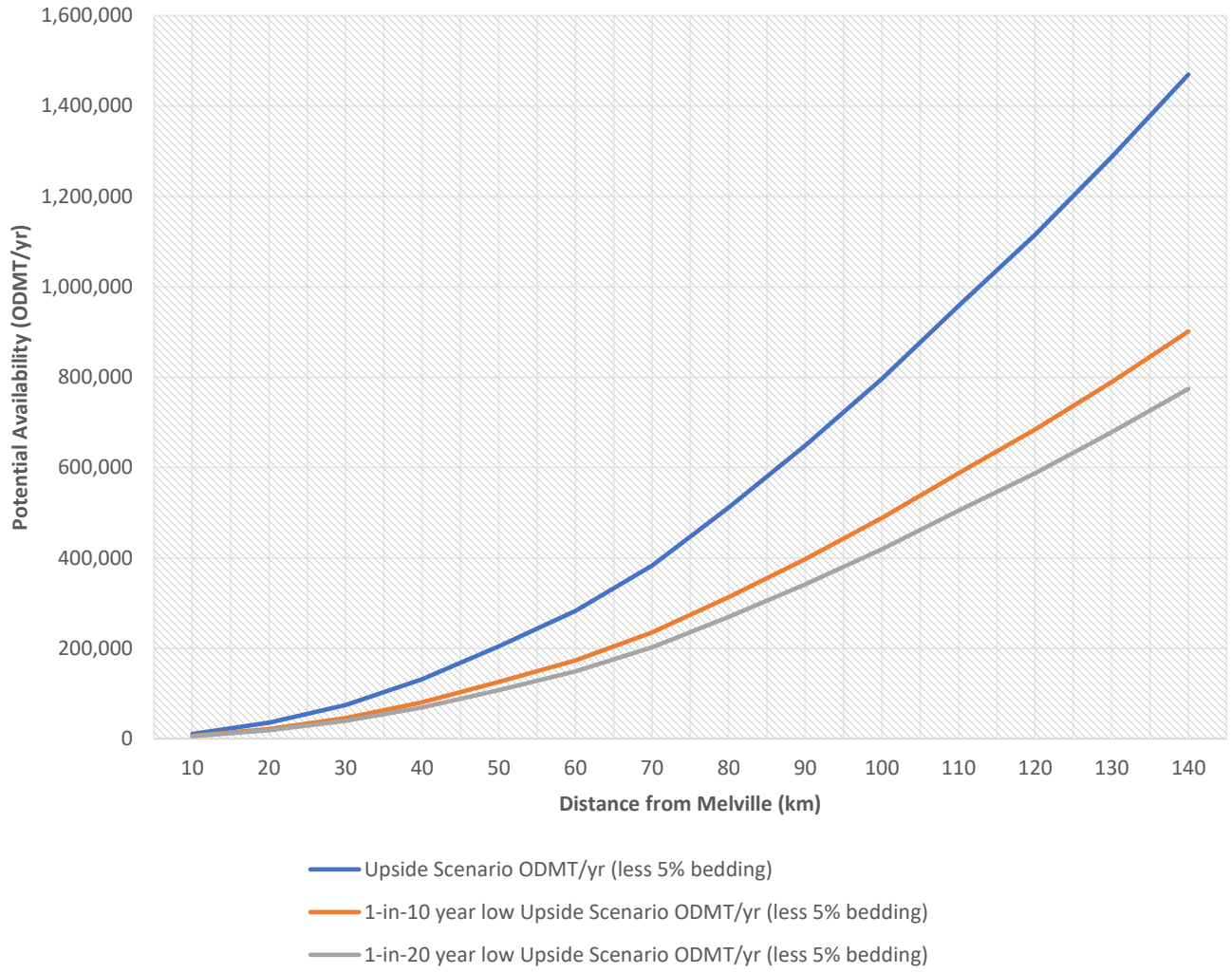
Figure 5:
Feedstock supply curve -- *Expected* scenario assuming a 58% participation rate



Upside Scenario assuming a 58% participation rate

Figure 6 indicates projected feedstock availability under the *Upside* scenario, and assuming a 58% participation rate.

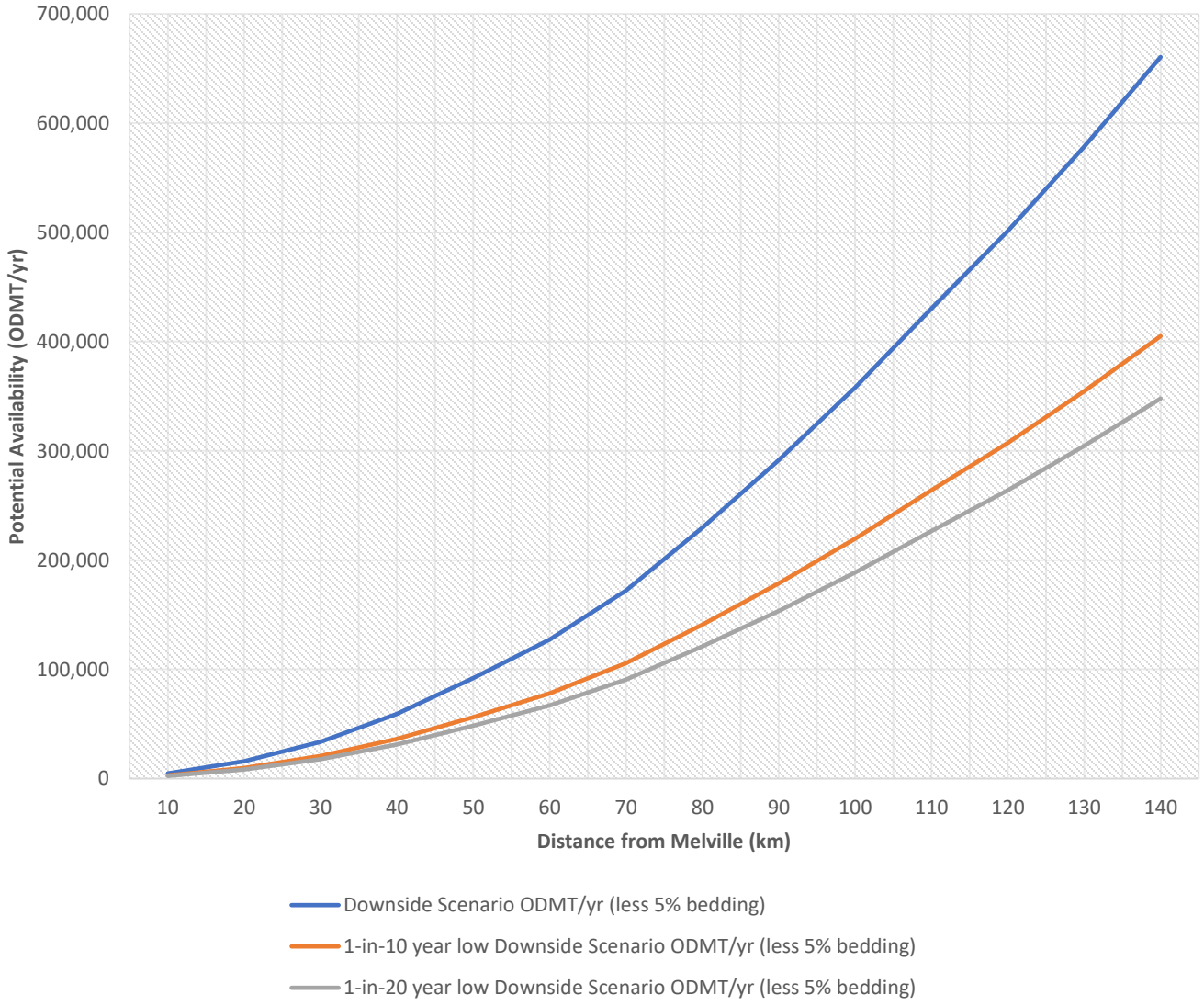
Figure 6:
Feedstock supply curve -- *Upside* scenario assuming a 58% participation rate



Downside Scenario assuming a 58% participation rate

Figure 7 indicates projected feedstock availability under the *Downside* scenario, and assuming a 58% participation rate.

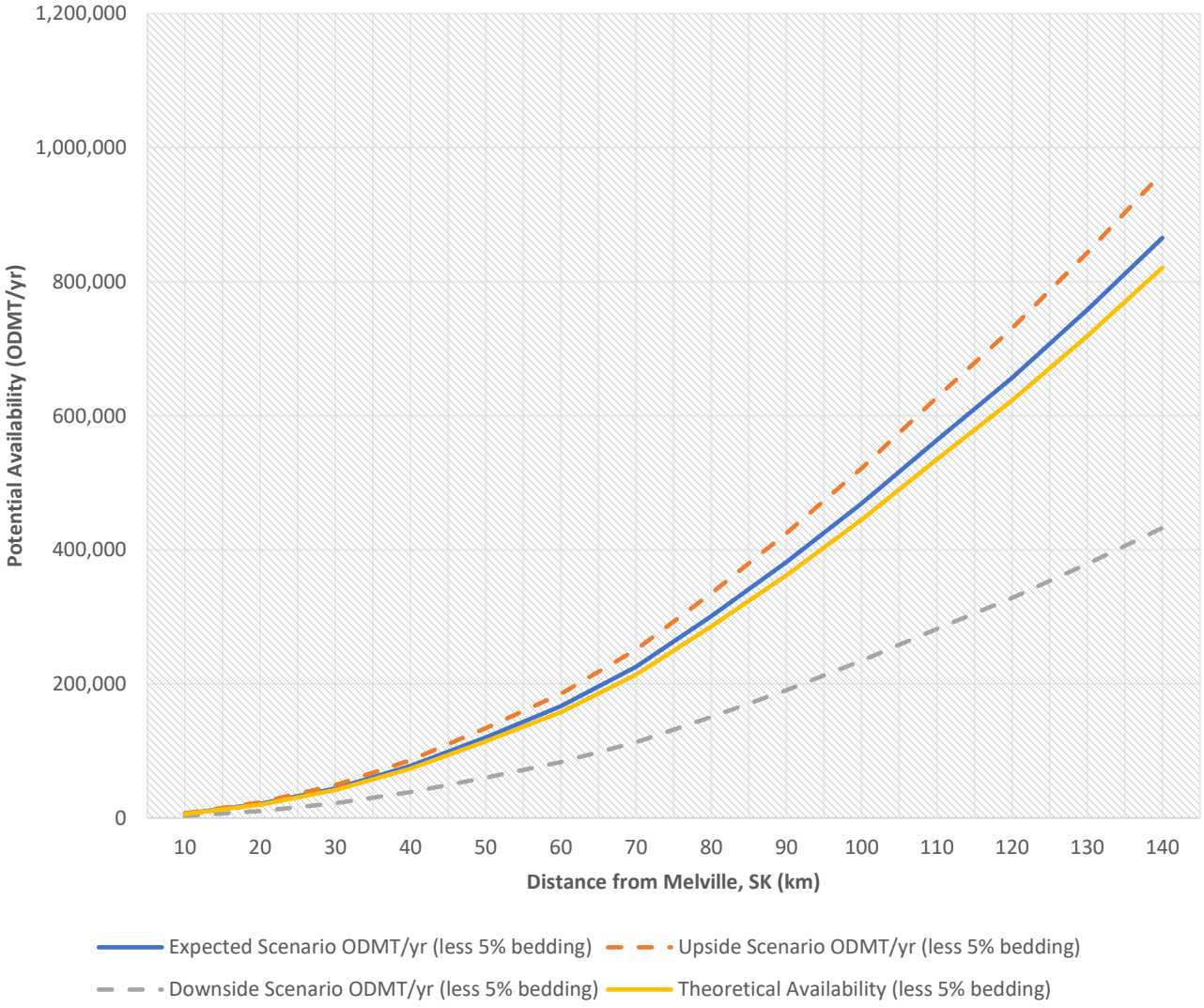
Figure 7:
Feedstock supply curve -- *Downside* scenario assuming a 58% participation rate



38% participation rate

This subsection provides an analysis of projected feedstock supply and costs based on a 38% participation rate assumption. Figure 8 compares supply curves for the *Expected*, *Upside*, and *Downside* scenarios. More detailed analysis of projected availability under each scenario is provided below.

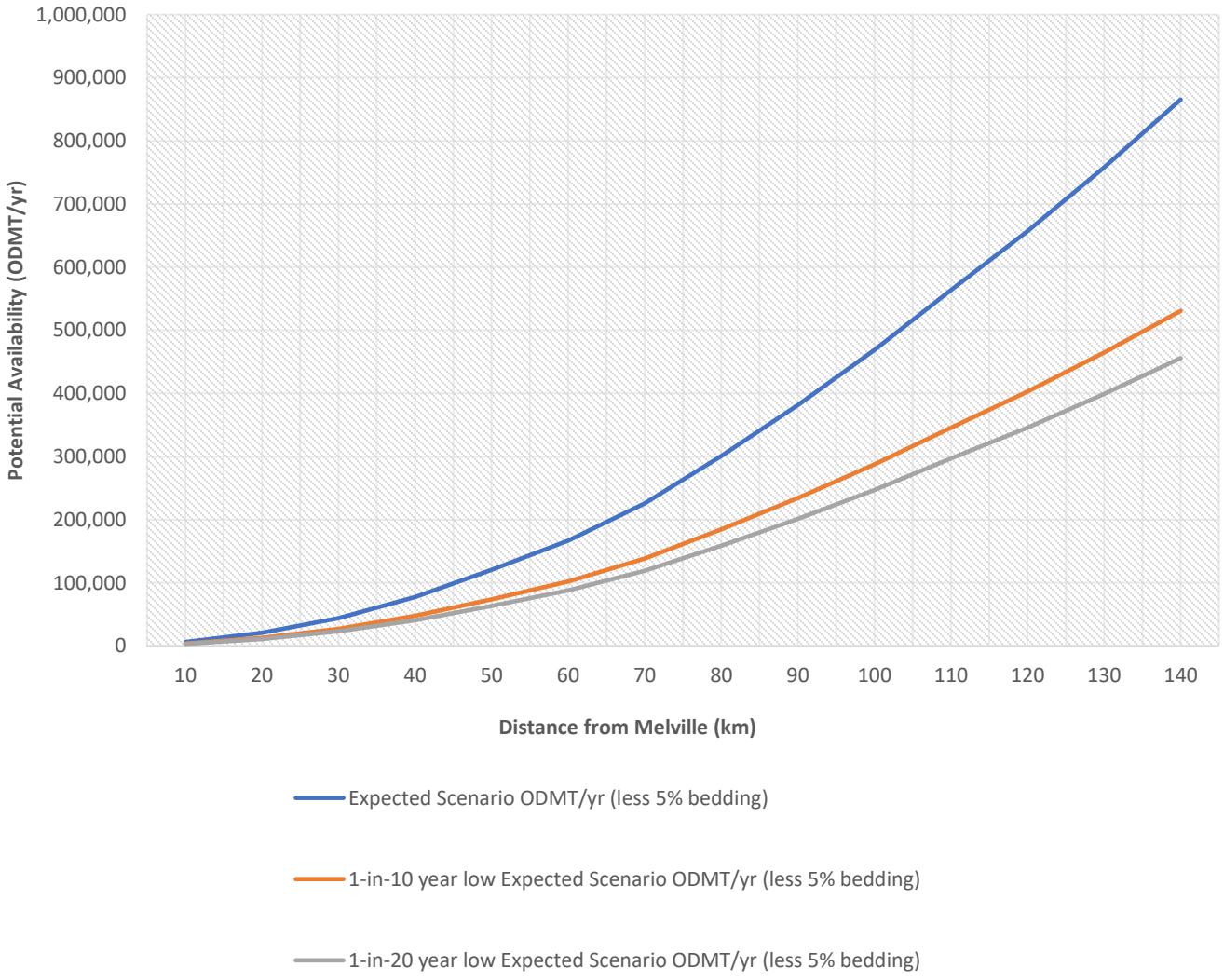
Figure 8: *Expected*, *Downside*, and *Upside* scenarios assuming a 38% participation rate



Expected Scenario assuming a 38% participation rate

Figure 9 indicates projected feedstock availability under the *Expected* scenario, and assuming a 38% participation rate.

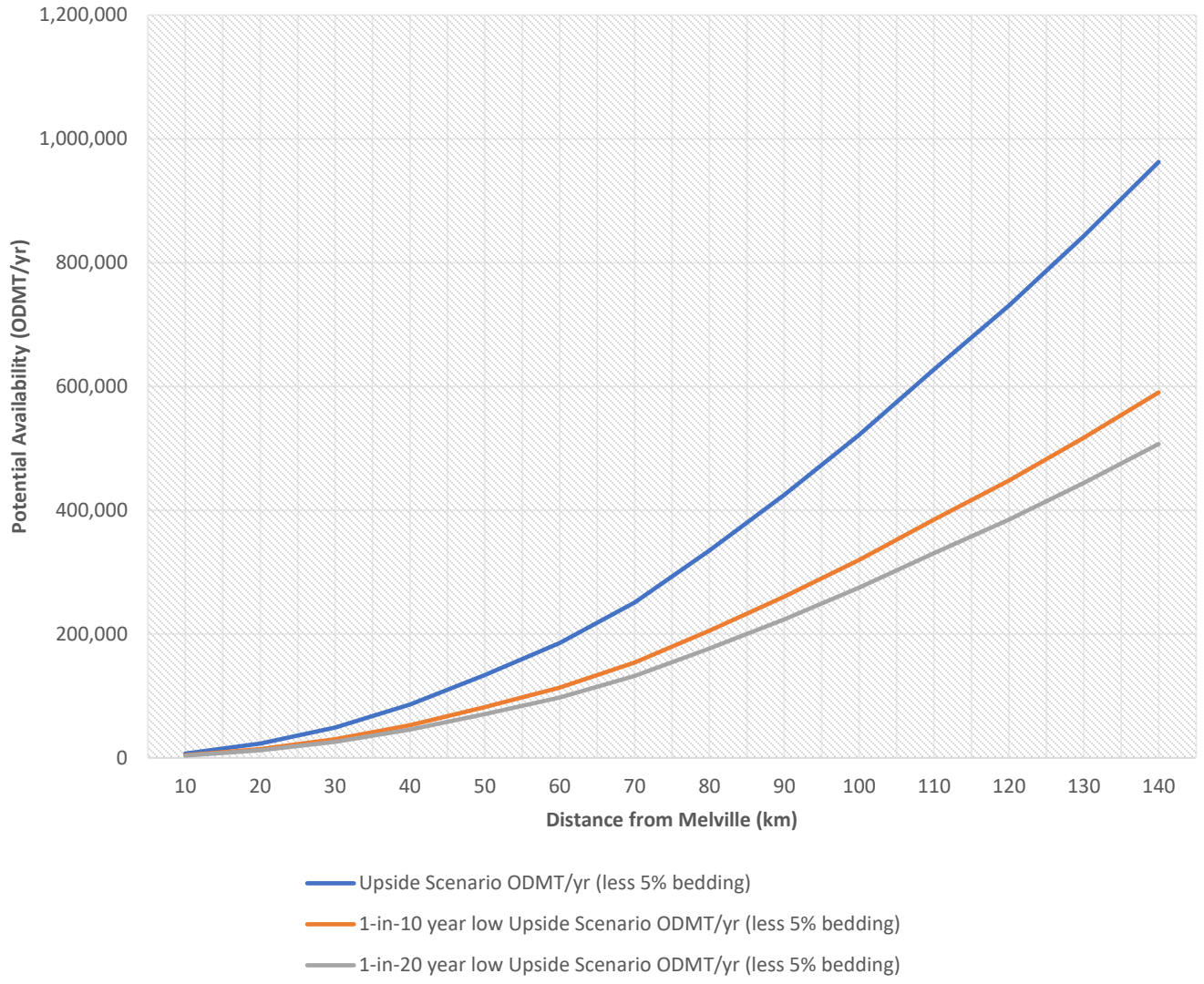
Figure 9:
Feedstock supply curve -- *Expected* scenario assuming a 38% participation rate



Upside Scenario assuming a 38% participation rate

Figure 10 indicates projected feedstock availability under the *Upside* scenario, and assuming a 38% participation rate.

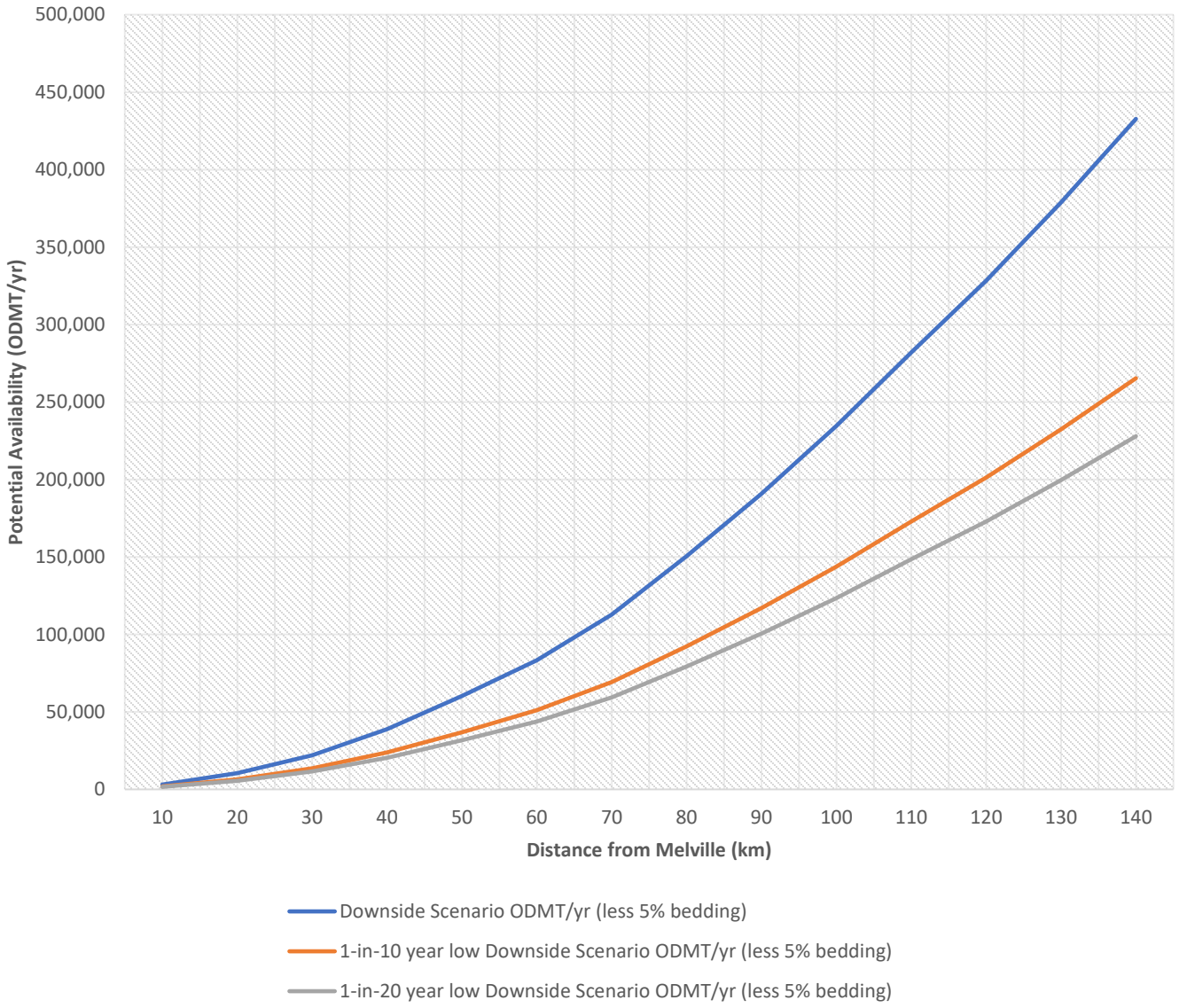
Figure 10: Feedstock supply curve -- *Upside* scenario assuming a 38% participation rate



Downside Scenario assuming a 38% participation rate

Figure 11 indicates projected feedstock availability under the *Downside* scenario, and assuming a 38% participation rate. Under these assumptions, in an average year a project can acquire its feedstock requirement within 110 km of Melville, including 234,525 ODMT/yr within 100 km. In a 1-in-10-year low case a project can acquire its feedstock requirement within 150 km of Melville, including 265,337 ODMT/yr within 140 km. In a 1-in-20-year low case a project can acquire its feedstock requirement within 150 km, including 227,907 ODMT/yr within 140 km.

Figure 11: Feedstock supply curve -- *Downside* scenario assuming a 38% participation rate



APPENDIX C: LEGAL DISCLAIMER

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