Bioeconomy Development Opportunity Zone Rating | Clarksville, AR
Date of Issue: May 19 2023
BDO Zone Rating: **'AA'**

Bioeconomy Development Opportunity Zone Risk Rating

'AA'

The Clarksville Bioeconomy Development Opportunity Zone is rated "AA." Long-term outlook on feedstock quantity is deemed stable. Limited exposure to price risk over time.

Rating Parameters:

Rated Quantity	Category	Cost	BDO Zone Size
150,000 tons/year	**Poultry Litter**	**$35-$45/wet ton delivered**	**75 miles ex. Clarksville**

BDO Zone Assets

- **Stable long-term outlook on quantity, reliability and supply chain resiliance.**
- **16x Biomass Availability Multiple: 2.4 million tons of PL generated within the BDO Zone.**
- **Key supply chain components are well developed and mature.**
- **3,550 poultry producers in the BDO Zone. Supply chain redundancy is high. Risk of supply disruptions due to individual supplier failure is low.**
- **Local support for PL-utilizing project development.**

BDO Zone Liabilities

- **PL cost fluctuates with cost of manufactured fertilizer. Exposure to price risk over time.**
- **PL is land-applied as fertilizer. There is no limit on land-applying PL.**
- **PL quality can fluctuate. Current land-application markets are tolerant to PL quality. A new project should tolerate the existing PL quality.**

Clarksville, AR BDO ZONE



BDO Zone Risk Rating

The Clarksville BDO Zone is rated "AA" or low risk for poultry litter ("PL") feedstock supply and supply chain infrastructure.

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

Scoring and Ratings Methodology

In assessing the biomass supply chain risk for Clarksville, 48 Risk Indicators from the *US Biomass Supply Chain Risk (BSCR) Standards* were applied. These BDO Zone Risk Indicators are the subset of BSCR Risk Indicators applicable to gauging feedstock risk within a BDO Zone.

Feedstock Quantity is expressed in tons. Feedstock cost is expressed in US dollars, delivered to the Clarksville area.

The BDO Zone rating is based on an aggregation of the scores assigned to each BDO Zone Risk Indicator (RI) assessed in this report. First, each BDO Zone Risk Indicator is given a **Raw RI** score based on the research and analysis conducted on the feedstock supply chain in the region. 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** 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 are reduced based on the efficacy of the likely mitigation measures. If applicable, notching occurs at one of 3 levels: 25%, 50%, or 75%.

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).*

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Impact level scores are based on the assumption that key measures were implemented to mitigate uncertainty drivers in the BDO Zone but failed to do so.

The Loaded RI score for each Risk Indicator is then calculated as the product of Notched Salience and Impact Level scores. For example, Risk Indicator 'Feedstock Availability' is scored at 1 and Impact Level is deemed high (i.e., 9.99). The final Loaded RI score for this risk indicator is 1 x 9.99 = 9.99 (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 BDO Zone is the average of all Loaded RI scores. The BDO Zone score for Clarksville, AR is ***10.82 out of 100, resulting in an "A" designation.*** All scoring and rationale for each Risk Indicator is provided in Appendix A.

Analyst Notes

The Clarksville BDO Zone is indicated by the red outline in the map above, representing a 75-mile drive distance from Clarksville, AR. Appendix C shows this map in greater detail.

PL includes manure from chicken or turkeys, and can include residual wood shavings or rice hulls that are used as bedding in poultry houses. Clearing of PL is variable among farmers, but once a year is typical.

Key BDO Zone Assets

The Clarksville BDO Zone presents several strong supply chain assets. We note, in particular, strong, steady and reliable generation of large volumes of poultry litter: an estimated 2.4 million tons are generated within the 75-mile BDO Zone.

At least 3,550 potential PL suppliers exist within the BDO Zone. Supply chain redundancy is high. Risk of supply disruptions due to individual supplier failure is very low.

Poultry production in the region is well-established and has steadily increased since 2011, by 27%. Many PL producers in the region are in the process of expanding operations on the assumption that growth will continue.

Fundamental drivers of PL production are strong and expected to maintain: PL generation keys directly to poultry production, and therefore an increase in poultry production is expected to correlate with an increase in PL generation. We find the fact that PL is a necessary by-product of poultry production to be an asset that speaks to the reliability and consistency of production.

Key supply chain components are well-developed and mature. The supply basin has a history of large-scale PL procurement, and producers have sufficient expertise in PL production to ensure reliable supply. PL production, storage, and removal are not drivers of material risk. Transportation infrastructure is mature with a robust network of third-party haulers and aggregators operating in the BDO Zone. New markets for PL will be able to leverage the available existing supply chain infrastructure.

Supply of PL is price driven: producers will generally sell to the highest bid and ground level support by producers is high for alternative markets that can match or exceed prices paid by traditional land application markets.

Nutrient loading in the local watershed is a major environmental and political issue in the area. We expect that alternate markets for PL that reduce nutrient loading will enjoy local support. Alternative disposal methods could become necessary as current legal cases pertaining to nutrient loading in the state develop; however, we note that a state restriction or ban on use of PL for land application would exert significant *downward pressure* on PL costs and be strongly favorable to alternative markets to land application.

In addition to creating new jobs, the development of a PL-processing bio-facility would help address one of the region's major political and environmental problems in a sustainable fashion.

Price fluctuation for PL is a risk for producers and we find it reasonable to expect that some would enter into longer-term supply contracts that enable them to mitigate that risk.

Anecdotal on-the-ground feedback from PL aggregators and producers in the region suggests that a biomass development in the region would widely be accepted and encouraged. Risk associated with backlash against biomass plant development, procurement or usage in the region is deemed low.

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Salient Risk Indicators

PL is a substitute for manufactured fertilizer in the region and current markets for PL are almost exclusively land application for soil amendment or fertilizer.

The primary factor driving competitive use of PL is cost: litter is a low-cost substitute for manufactured fertilizer. As a result, the landed cost of PL follows the pricing curve for fertilizer – when fertilizer cost goes up, so does the cost of PL, and vice-versa. While the cost of manufactured fertilizer at any given time acts as an effective cap to the cost of PL, new markets for PL are exposed to material price volatility risk due to fluctuations in manufactured fertilizer cost. We note that fertilizer prices had been decreasing since 2014 before increasing significantly in the first half of 2021: if sustained, such a trend would put upward pressure on PL cost.

Over the long term, we see limited but material exposure to price (but not quantity) risk in the BDO Zone. We proxy historical standard deviations in manufactured fertilizer costs to estimate forward fluctuations in PL cost.

PL has clear but not significant exposure to diesel prices. We find sensitivity of delivered PL cost to reasonable forward expectations of gas/diesel prices to be *low to moderate*.

It is clear that, as a feedstock, PL is not wholly homogeneous in composition or nutritive value, and different types of bioprocessing facilities may be more or less impacted by the variability. A rigorous and statistically relevant sampling and testing procedure of PL to ensure viability with specific plant technology is recommended.

Datasets pertaining to PL purchase cost, local fertilizer costs, and land-application costs are rare and most are incomplete. The most recently available data on litter generation estimates were from the USDA (2017) and lack nuance and granularity. Much of the pricing data utilized in this rating is based on direct feedback from poultry producers, PL brokers and aggregators, and land-application markets in the region. While every effort was made to triangulate and confirm data points, front-end validation was not possible in many cases.

Infrastructure Asset Profile

Clarksville BDO Zone's infrastructure assets are scored on a scale of 1 - 10, with scores defined as follows: 1 (*very good*), 2 (*good*), 4 (*reasonable*), 6 (*fair*), 8 (*poor*), 10 (*insufficient*). Most assets are scored as either *good* or *very good*, and none are scored as *poor* or *insufficient*. Overall, Clarksville BDO Zone presents a profile of positively rated infrastructure assets, with an average score of **1.92**. This score supplements Clarksville BDO Zone rating, and reinforces its **AA** (*low risk*) designation. The full infrastructure asset profile is detailed in *Table 2* and *Appendix B*.

Technical Contact
Marcin Lewandowski
Senior Director, Operations & Risk
Ecostrat Inc.
marcin@ecostrat.com

Project Principal
Matt Dickson
Project Principal
Ecostrat Inc.
matt@ecostrat.com

Business Contact
Jordan R. Solomon
President & CEO
Ecostrat Inc.
jordan.solomon@ecostrat.com

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Figure 1 - Risk Indicators (Sorted by Risk Level)

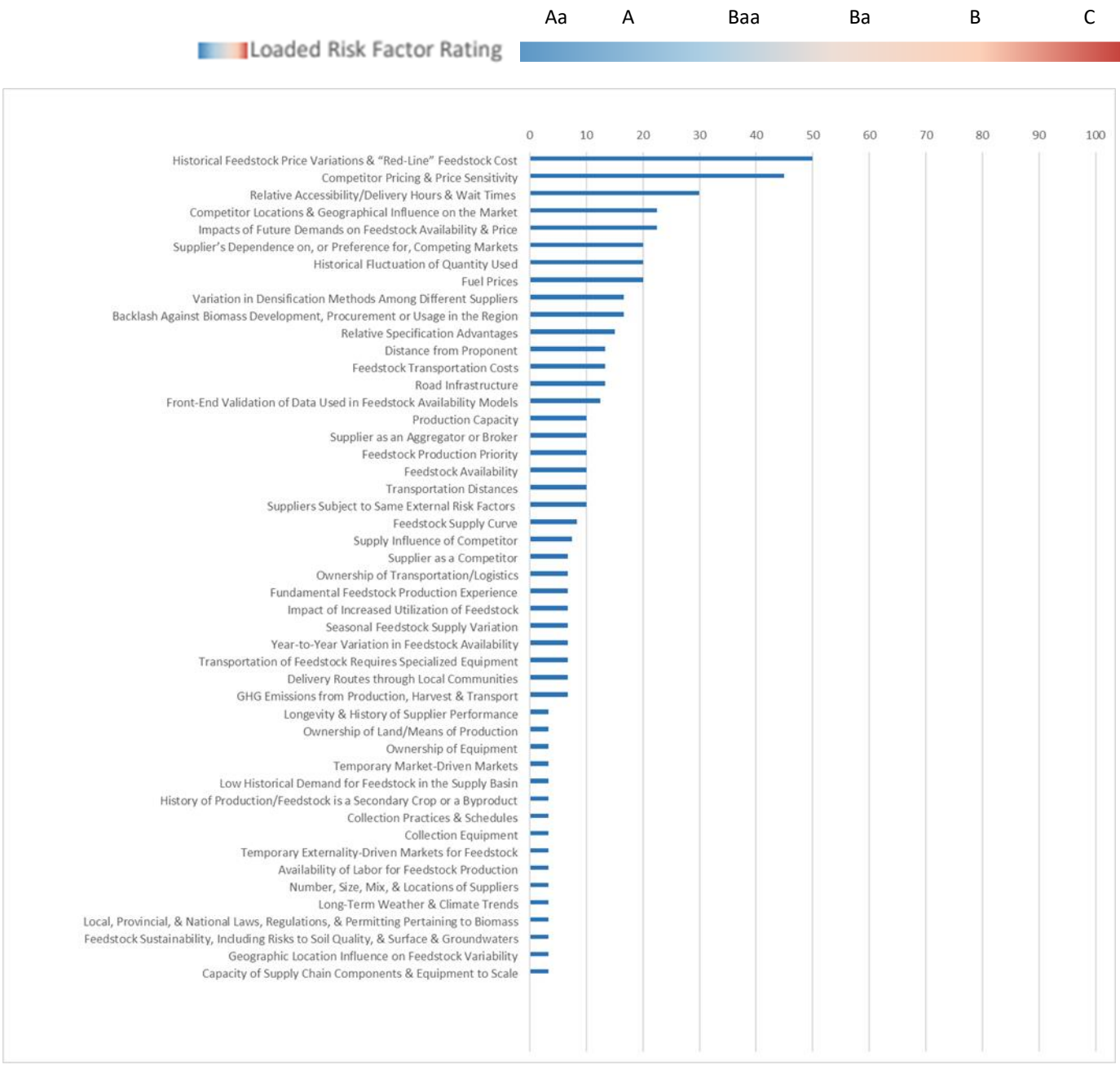

Table 1. Risk Indicators

Feedstock Supply Chain Risk Indicators	Raw RI Score	Notched Salience	Impact Level	Loaded RI Score
Category 1: Supplier Risk				
Longevity & History of Supplier Performance	1	1.0	3.33	3.33
Production Capacity	1	1.0	9.99	9.99
Supplier's Dependence on, or Preference for, Competing Markets	2	2.0	9.99	19.98
Supplier as a Competitor	1	1.0	6.66	6.66
Ownership of Land/Means of Production	1	1.0	3.33	3.33
Ownership of Equipment	1	1.0	3.33	3.33
Ownership of Transportation/Logistics	2	2.0	3.33	6.66
Supplier as an Aggregator or Broker	2	1.0	9.99	9.99
Distance from Proponent	2	2.0	6.66	13.32
Fundamental Feedstock Production Experience	1	1.0	6.66	6.66
Feedstock Production Priority	1	1.0	9.99	9.99
Category 2: Competitor Risk				
Competitor Locations & Geographical Influence on the Market	9	2.25	9.99	22.48
Historical Fluctuation of Quantity Used	6	6.0	3.33	19.98
Competitor Pricing & Price Sensitivity	9	4.5	9.99	44.95
Impacts of Future Demands on Feedstock Availability & Price	3	2.25	9.99	22.48
Supply Influence of Competitor	3	2.25	3.33	7.49
Temporary Market-Driven Markets	1	1.0	3.33	3.33
Relative Accessibility/Delivery Hours & Wait Times	6	3.0	9.99	29.97
Relative Specification Advantages	6	1.5	9.99	14.98
Category 3: Supply Chain Risk				
Feedstock Availability	1	1.0	9.99	9.99
Impact of Increased Utilization of Feedstock	1	1.0	6.66	6.66
Feedstock Supply Curve	5	1.25	6.66	8.32
Seasonal Feedstock Supply Variation	1	1.0	6.66	6.66
Year-to-Year Variation in Feedstock Availability	1	1.0	6.66	6.66
Front-End Validation of Data Used in Feedstock Availability Models	5	1.25	9.99	12.49
Historical Feedstock Price Variations & "Red-Line" Feedstock Cost	5	5.0	9.99	49.95
Low Historical Demand for Feedstock in the Supply Basin	1	1.0	3.33	3.33
History of Production/Feedstock is a Secondary Crop or a By-product	1	1.0	3.33	3.33
Fuel Prices	3	3.0	6.66	19.98
Collection Practices & Schedules	1	1.0	3.33	3.33
Collection Equipment	1	1.0	3.33	3.33
Temporary Externality-Driven Markets for Feedstock	1	1.0	3.33	3.33
Variation in Densification Methods Among Different Suppliers	5	2.5	6.66	16.65
Availability of Labor for Feedstock Production	1	1.0	3.33	3.33
Feedstock Transportation Costs	4	4.0	3.33	13.32
Transportation Distances	3	3.0	3.33	9.99
Transportation of Feedstock Requires Specialized Equipment	2	2.0	3.33	6.66
Delivery Routes through Local Communities	2	2.0	3.33	6.66
Road Infrastructure	2	2.0	6.66	13.32
Number, Size, Mix, & Locations of Suppliers	1	1.0	3.33	3.33
Suppliers Subject to Same External Risk Factors	2	1.0	9.99	9.99
Long-Term Weather & Climate Trends	1	1.0	3.33	3.33
Local, Provincial, & National Laws, Regulations, & Permitting Pertaining to Biomass	1	1.0	3.33	3.33
Backlash Against Biomass Development, Procurement or Usage in the Region	5	2.5	6.66	16.65
Feedstock Sustainability, Including Risks to Soil Quality, & Surface & Groundwaters	1	1.0	3.33	3.33
GHG Emissions from Production, Harvest & Transport	2	2.0	3.33	6.66
Geographic Location Influence on Feedstock Variability	1	1.0	3.33	3.33
Capacity of Supply Chain Components & Equipment to Scale	1	1.0	3.33	3.33
			Total Composite Loaded Risk Score	**10.82**

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Table 2 - Asset Indicators

Infrastructure Assets	Overview	Score
Category 1: Physical Infrastructure		
1.1 Land Parcel	The City of Clarksville is an ideal land parcel of 12,288 acres (19.2 sq mi) located in Johnson County, Arkansas.	1
1.2 Industrial Land Use Zone	Clarksville has five prime locations suitable for manufacturing operations. Specifically, Clarksville Business Park is the city's largest municipally-owned industrial property with 120 acres located close to Interstate 40. Other Industrial sites in the region are- 36-acre site adjacent to N State Highway 109; 60-acre site adjacent to Sterlin Hurley Ind Hwy; 40-acre site adjacent to S Craxford St; and 108-acre site adjacent to S Crawford St.	1
1.3 Natural Gas Line	Black Hill provides Natural Gas to all five Industrial sites. The 120-acre business park has a 3" Gas line on-site, 20,000 cubic feet per hour capacity, which can be upgraded to booster station for an increased capacity up to 400 MCFH.	2
1.4 Electrical	All five Industrial sites have an Electric- Distribution of 12.45 KV provided by Clarksville Connected Utilities.	2
1.5 Fresh Water Supply Line	Clarksville Connected Utilities provides a Water line of 16" to the 36-acre property; and 12" Main line to other properties; excluding the 108-acre property. Although no water line is currently available there, it can be supplied by Clarksville Connected Utilities. The 120-acre business park has water supply in excess capacity with recent $10 Million Expansion, Ozone Gas Disinfection and a historic peak of 12.5 mgd that can be increased up to 24 mgd.	3
1.6 Sewage Disposal	Clarksville Connected Utilities provides a Sewer line of 8" on the West and 10" on the East side of the 120-acre property; and a 6" main on the 60-acre property. However, other sites do not have sewers at the moment but can be served by the city.	4
1.7 Drainage	Monthly sewer rates for industrial purposes are applicable based on the quantity of drainage. There is a monthly base rate plus additional charge for every 1000 gallon as per the City Government.	2
1.8 Stormwater Management	The stormwater drainage system in Clarksville consists of a network of pipes, culverts, channels, and detention ponds to manage the stormwater runoff efficiently.	2
1.9 Available ICT (Information & Communication Technology) Services	All five Industrial sites have a Fiber optic network of 1+ gigabyte bandwidth capacity provided by Clarksville Connected Utilities. A newly installed fiber optic network feeds government facilities, businesses and residential areas with a dedicated 17+ mile 288 fiber network ring throughout the City of Clarksville. This state-of-art municipally owned network is capable of deploying gigabyte bandwidth capacity.	2
1.10 Landfill/waste disposal	Solid Waste Management is carried out by West River Valley Regional District. Johnson County Landfill in Clarksville has a capacity of 60,000 tpy and takes in all non-hazardous waste except liquids. There are also multiple transfer stations and waste haulers within the city. Also, the City of Clarksville Recycle Center accepts many types of recyclable materials.	2
Category 2: Logistics		
2.1 Highway Access and Intersection	The Clarksville Business Park is bound by Interstate 40 to the North and Massengale Road to the North and East. It is also in close proximity to Highway US-64, HWY 103, US Hwy 64 and State Hwy 109.	1
2.2 Ocean/River Access	The Primary Navigable Water Arkansas River is 3.1 miles; Port of Dardanelle is 23.4 miles; Port of Fort Smith is 47.9 miles; Poteau River is 51.7 miles and Port of Little Rock is 79.8 miles away.	1
2.3 Accessibility to Airports	Clarksville Municipality Airport (4.8 miles) can be reached in 10 minutes, Paris Municipality Airport (14.1 miles) can be reached in 20 minutes, Fort Smith Regional (51.7 miles) can be reached in 54 minutes and Little Rock National (87.2 miles) can be reached in 1 hour 25 minutes.	1
2.4 Railway Service	Union Pacific Railroad is 2 miles; and Dardanelle & Russellville Railroad is 23.4 miles from the Business Park. The Union Pacific Railroad runs through Johnson County and provides mainline rail service to ports and markets throughout the United States.	2

2.5 Logistics-Construction	Clarksville has good labor force to manage construction projects seamlessly. Also, the boring samples taken from Clarksville Industrial Park reveal it to be an ideal ground for large foundational construction.	2
Category 3: Social Infrastructure		
3.1 Quality of Life	Clarksville has a livability score of 72/100, which puts it in the "good" category. This score takes into account several factors including cost of living, education, employment, housing, weather, crime rate, and amenities. The cost of living in Clarksville is 30.1% lower than the U.S. average.	2
3.2 Education	Clarksville has 5 Preschools, 6 Elementary Schools, 3 Middle Schools, 2 High Schools, 5 Public District Schools and 7 Private Schools. Clarksville High School is ranked #79 Best Public High School in Arkansas. The Clarksville School District has a graduation rate of over 92%. The largest University in Clarksville is the University of the Ozarks, a Private University that ranks #7 in Regional Colleges South. Within a 60-mile radius of Clarksville, there are multiple Higher Education Institutions like Arkansas Tech, University of Arkansas Fayetteville, University of Arkansas Fort Smith, Hendrix College and University of Central Arkansas. Approximately 37% of Clarksville residents have a College Education.	2
3.3 Local Retail	Clarksville has the presence of Corporates such as Walmart, Tyson, Hanes Brands Inc, Munro, Greenville Tube company, Pictsweet, Piney Bay Coffee and M1. There are also other local grocery and convenience stores, big box home improvement, malls, restaurants and retail outlets in good number to serve the city's community.	2
3.4 Culture and Recreation	Clarksville hosts several community events throughout the year, including the Johnson County Peach Festival and the Ozark Mountain Bike Festival. The city is well known for its scenic byways and abundance of natural outdoor recreational activities. It is also well equipped with amenities such as parks, lakes & rivers, trails, youth activities, aquatic centre etc.	2
3.5 Hospital and Doctors	There are 11 Medical Clinics and 5 Hospitals within 25-mile distance from Clarksville. Johnson Regional Medical Center is the primary hospital in Clarksville and has good number of Doctors in all Departments.	2
3.6 Housing Availability	The median property value in Clarksville was $ 128,800 in 2020, which is 0.56 times smaller than the national average of $ 229,800. The homeownership rate in Clarksville is 51.3%, which is lower than the national average of 64.4%. A significant number of units rented in Clarksville are between $ 600 to $ 700, whereas the high-end rentals range between $ 1,000 to $ 1,200. Also, the housing occupied is 87.88%, and vacant is 12.12% in the city.	2
3.7 Crime rate	The crime rate in Clarksville is 13.9% and is lower than the national average.	2
Category 4: Workforce		
4.1 Labour Rates	The federal minimum wage in the United States is $ 7.25 per hour since 2009. However, in Arkansas, the state minimum wage is currently $ 11.00 per hour, which is higher than the federal minimum wage.	2
4.2 Employment Rates	According to the United States Census Bureau 2020, the median household income is $ 44,183 and the per capita income is $ 21,889. The hourly rates vary but are majorly between $ 11 to $ 24 based on the profession; and the highest paying industries in the city are Finance & Insurance ($75,433) and Real Estate ($71,667).	3
4.3 Available Skilled Labour	There is an abundance of highly skilled professionals in all industries. Some of the major occupations in the region are- Manufacturing (1,221); Accommodation & Food Services (583); and Retail Trade (560). Compared to other places, Clarksville has an unusually high number of residents working in Production (3.42 times higher), Material Moving (3.06 times), Law Enforcement (4.07 times), Manufacturing (2.89 times) and Utilities (1.96 times). Clarksville's economy is heavily dependent on manufacturing, which represents nearly 40% of all jobs within the city. The next three largest sectors include health care (14%), retail (13%), and transportation & warehousing (13%).	1
4.4 Available Unskilled Labour	Clarksville has good number of unskilled workers serving different industries.	2
4.5 Workforce size	According to the United States Census Bureau 2021, Clarksville has a total labour force of 7,674 with an employment rate of 98.45%, and an unemployment rate of 1.55%. The median age in the region is 35, and there are approx. 5349 people between the age of 20 to 64.	2
	Total	***1.92***


BIOECONOMY DEVELOPMENT OPPORTUNITY ZONE PROGRAM
CERTIFIED 'AA'

APPENDIX A: RISK INDICATOR SCORING METRICS

CATEGORY 1: SUPPLIER RISK

1.1. Longevity & History of Supplier Performance

Rationale: Number of years in business is a positive indicator of future solvency. Historical performance is an indicator of future performance.	
Raw RI Score: Producers raising broilers and turkeys for meat, and layers for eggs have been operating in Arkansas on a large-scale for decades.[1] Today, over 1 billion broilers and 27 million turkeys are raised annually in Arkansas, making it the third largest state in the United States for total pounds of chicken and turkey meat production. Furthermore, over 4.2 billion eggs are produced annually in Arkansas (making it second nationally in value of egg production).[2] Assuming an industry average of 265 eggs/layer/year,[3] this equates to approximately 16 million layers. Risk associated with longevity and history of supplier performance is deemed very low. Raw RI score is 1 out of 10.	**Score 1**
Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: The uncertainty in the Raw RI Score is low and the risk's eventual impact would be limited due to the large number of potential PL suppliers. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience x Impact Level) is 3.33 out of 100.	**Score 3.33**

1.2. Production Capacity

Rationale: Supplier production capacity can be a strong indicator of long-term credit worthiness and future solvency. Higher production capacities can denote strength of operational elements, including cash flows, that are important to future solvency.	
Raw RI Score: Through internal modeling and conversations with local experts, it is estimated that over 2.4 million tons per year (tpy) of PL (1.9 million from broilers and 0.5 million from turkeys) is generated in the Clarksville BDO Zone supply basin. It is also estimated that over 96,000 tpy of PM is generated. Due to the small amount of PM generation, coupled with its lack of bedding material (making it a very attractive fertilizer), only PL availability is considered from this point forward. PL is a direct by-product of broiler and turkey production. As such, and due to the poultry industry's strength in the region, future generation of PL in the Clarksville BDO Zone supply basin is seen to be stable and robust. Furthermore, poultry production in Arkansas (measured in pounds of meat production) increased by more than 27% from 2011 to 2021.[4] It is reasonable to assume that this trend	**Score 1**

1 Encyclopedia of Arkansas: https://encyclopediaofarkansas.net/entries/poultry-industry-2102/
2 The Poultry Federation Facts & Figures (2022): www.thepoultryfederation.com/images/2022_State_Quick_Fact_Cards-AR-WEB.pdf
3 In April 2022, egg production in Arkansas totaled 347 million eggs from 15.8 million layers. This is equal to 22 eggs/month/layer or 264 eggs/year/layer. www.nass.usda.gov/Statistics_by_State/Arkansas/Publications/Livestock_Releases/Chicken_Egg/2022/arce052022.pdf
4 USDA, Agricultural Statistics Service Delta Region Arkansas Field Office: www.nass.usda.gov/Statistics_by_State/Arkansas/Publications/Livestock_Releases/Production_and_Value/arbroilerPV.pdf

will continue. Therefore, and because increased poultry production results in increased PL generation, it is also reasonable to assume that the amount of PL generated in the Clarksville BDO Zone supply basin will also continue to increase.

Risk associated with production capacity is deemed to be very low. Raw RI Score is 1 out of 10.

Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: There is some uncertainty built into our assessment of production capacity as the estimates are based on general conversion factors. Also, the impact of the risk would be significant. RI Impact level is deemed high.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99 out of 100.	**Score 9.99**

1.3. Suppliers' Dependence on, or Preference for, Competing Markets

Rationale: Supplier may have a vested interest in or preference for supplying specific competitors for biomass feedstock. Preferences may be due to historical, long-term, or personal relationships, less stringent feedstock quality requirements, more flexible operating hours by competing markets, or suppliers' dependences on competing markets to accept or purchase other products/by-products. During periods of feedstock shortage such suppliers may be more likely to allocate the scarce supply to a competitor, resulting in supply disruptions for the Proponent.	
Raw RI Score: PL is a lower-cost, lower quality alternative to manufactured fertilizer, and as such, land-application currently represents the primary use of PL in the Clarksville BDO Zone supply basin. However, the current use of PL as a fertilizer isn't due to vested interest or preferences of poultry producers, but rather a lack of alternative options.[5] Therefore, it is anticipated that existing competitors and/or markets will not materially affect the ability of new bio-based facilities to obtain PL for these reasons: • The market for PL fertilizer tends to be spot-based and price-driven. At comparable prices, bio-based facilities should be able to secure significant PL quantities; • Poultry producers aren't currently offered long-term contracts for their PL. Bio-based facilities offering long-term PL contracts would be well received by local producers; • Key intermediaries and poultry producers in the Clarksville BDO Zone supply basin have indicated a willingness to supply PL to new bio-based facilities; and • Many bio-based technologies don't use or consume nutrients. As such, the nutrients in PL would still be available after use for land-application. Risk associated with suppliers' dependence on, or preference for, competing markets is deemed to be low. Raw RI Score is 2 out of 10.	**Score 2**

[5] During discussions with industry experts, there was little mention of goodwill or longstanding personal relationships between poultry producers and PL end-users.

Notched Salience: No adjustment.	**Score Unnotched 2.0**
Impact Level: Our assumptions behind the fact that poultry producers would not have a preference over markets as long as a new bio-project can outbid the current market are based on feedback from market experts, and are therefore prone to error. If suppliers indeed prefer to supply to local farmers, the impact of this risk indicator would be significant. Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 19.98 out of 100.	**Score 19.98**

1.4. Supplier as a Competitor

Rationale: The risks of feedstock costs going up and availability going down increase if a supplier is also a competitor to the Proponent. In times of feedstock shortage, the risk that supply commitments will not be met increases.	
Raw RI Score: Poultry producers typically have minimal land, instead choosing to buy rather than grow their own feed. For this reason, poultry producers in the Clarksville BDO Zone supply basin typically use very little, if any, of the PL they generate. Risk of suppliers serving as competitor for feedstock is deemed to be very low. Raw RI is 1 out of 10.	**Score 1**
Notched Salience: No adjustment. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: We are certain of our assessment of this risk indicator. However, in case large poultry producers decide to enter the market for PL, the impact could be significant, albeit likely local. Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

1.5. Ownership of Land/Means of Production

Rationale: Suppliers that own land where feedstock is produced, or a production facility, tend to have better control of supply chains and present lower degrees of supply risk.	
Raw RI Score: Poultry producers in the Clarksville BDO Zone supply basin typically own the land and barns in which their broilers and turkeys are raised. Risk associated with ownership of land and means of production is deemed to be very low. Raw RI is 1 out of 10.	**Score 1**
Notched Salience: No adjustment. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: Although in certain cases poultry producers may not own the land or barns they operate in, it would not negatively affect the supply chain. Impact Level is deemed *low*.	**Score 3.33**

Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

1.6. Ownership of Equipment

Rational: In most cases, suppliers which own or lease equipment for collection and processing feedstock are lower risk than those who do not. For example, third-party collection equipment may not be available when required.	
Raw RI Score: PL is an unavoidable by-product of poultry production. When broiler and turkey barns are cleaned out, PL is removed using simple equipment commonly owned by poultry producers. Once removed, PL is simply transported elsewhere and doesn't require any processing. Risk associated with ownership of equipment is deemed to be very low. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

1.7. Ownership of Transportation/Logistics

Rationale: In most cases, suppliers that own or lease equipment necessary to transport biomass from production site are lower risk than those who do not. However, in some circumstances, reliance on third parties to transport biomass is a common practice and does not contribute to risk.	
Raw RI Score: Due to their ability to transport greater volume, live-bottom or walking-floor trailers are most often used to transport PL in the Clarksville BDO Zone supply basin. While these trailers are semi-specialized equipment and relatively expensive (versus simple dump trailers), the transportation of PL is carried out almost exclusively by well-established third-party trucking companies that own these vehicles. Risk associated with ownership of transportation/logistics is deemed to be low. Raw RI is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score Unnotched 2.0**
Impact Level: We are confident that the transportation aspect of the PL supply chain is in place and therefore we do not regard this risk indicator as having a significant influence on the risk profile. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

1.8. Supplier as an Aggregator or Broker

Rationale: Aggregators may effectively provide supply chain redundancy and eliminate the risk and complexity of dealing with multiple sources of supply by combining supplies into a single master contact. Aggregators can add much needed stability in BDO Zones by increasing offtake stability for both suppliers and markets. An aggregator can be a more reliable long-term offtake for suppliers by virtue of having multiple markets and can be a more reliable long-term supplier for markets by virtue of having multiple suppliers. Further, when a single supplier breaches, the aggregator can source from another.	
Raw RI Score: A few local transportation companies handle a significant proportion of the PL generated in the Clarksville BDO Zone supply basin. As such, there is good possibility that the risk and complexity of dealing with multiple poultry producers could be eliminated by working with these transportation companies instead. That being said, a few large aggregators can wage significant control over the supply chain and PL prices. Risk associated with supplier acting as an aggregator or broker is deemed to be low. Raw RI is 5 out of 10.	**Score 2**
Notched Salience: Raw RI is mitigated by the fact that this BDO Zone is rated for 150,000 tpy out of 2.4 million tpy generated. Therefore, even if aggregators have significant influence on the supply chain, the redundancy should ensure efficient competition in the market. We notch Raw RI by 50%, resulting in a score of 2.5.	**Score Notched 1**
Impact Level: It is unknown how much of the PL moved in the BDO Zone is controlled by aggregators. A few large aggregators can wage significant control over the supply chain and PL prices. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 24.97 out of 100.	**Score 9.99**

1.9. Distance from Proponent

Rationale: The greater the distance from a supplier to a plant, the more exposure it has to weather and fuel cost risks, and the greater the competitive pressure (to breach) that a closer competitor can exert.	
Raw RI Score: It is estimated that PL is generated by approximately 3,550 barns spread throughout the Clarksville BDO Zone supply basin. Approx. 1/3 of these barns are located within 35 miles of the Clarksville BDO Zone, in counties such as Johnson, Franklin, Logan, Yell and Pope County. Transportation distance from these barns to the Clarksville BDO Zone could be as close or closer than the fields where PL is currently land-applied. Risk associated with supplier distance from the proponent is deemed to be low. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score Unnotched 2.0**

Impact Level: Since transportation cost is a significant determinant of where PL is delivered to, poultry producers' distance to Clarksville can be significant. There is a degree of uncertainty with regards to the likelihood that a new bio-project would be more attractive than land-application, from transport perspective. RI Impact Level is deemed *medium*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 13.32 out of 100.	**Score 13.32**

1.10. Fundamental Feedstock Production Experience

Rationale: Risk is higher when a supplier has limited experience with collecting and/or processing biomass. In cases where experience is lacking, Proponent should show that steps have been taken to ensure proper training, knowledge dissemination and monitoring.	
Raw RI Score: Poultry producers in the region have extensive (in some cases generational) experience raising broilers and turkeys, and handling PL. Risk associated with fundamental feedstock production experience is deemed to be very low. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: Certain applications may have specific feedstock quality requirements. Although poultry producers have extensive experience in producing PL, its quality is uncertain. RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

1.11. Feedstock Production Priority

Rationale: When biomass feedstock is a secondary or non-core line of business, or when it is a by-product or a residual from a more valuable primary product, then suppliers may not put in sufficient effort to consistently produce it. Risk of breach increases when production and/or delivery of feedstock compromises a supplier's ability to make a primary product.	
Raw RI Score: PL, which is composed of a combination of excrement, bedding material, and waste feed derived from broilers and turkeys, is an inescapable by-product of the poultry production process. As a result, poultry producers are obliged to produce PL, irrespective of their preference to avoid it. This inherent characteristic of the industry implies that the generation of PL is an ongoing aspect of poultry production, which may have implications for the management of associated costs and environmental risks. Risk associated with feedstock production priority is deemed to be very low. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**

Impact Level: While it is true that PL is an inevitable outcome of poultry production, its composition can be influenced by the type of bedding material used in the production process. The variability of materials combined with PL introduces a level of uncertainty that could be material to a new bio-project. RI Impact Level is deemed *high.*	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99 out of 100.	**Score 9.99**

CATEGORY 2: COMPETITOR RISK

2.1. Competitor Locations and Geographical Influence on the Market

Rationale: Competitors' locations relative to a Proponent plant can affect the viability of procuring feedstock and the cost of that feedstock. Accurate and detailed competitor mapping provides an understanding of the geographical influence a competitor may have, including competitive advantages such as short-hauling.	
Raw RI Score: The primary competing use for PL in the Clarksville BDO Zone supply basin is land application as a lower-cost substitute for manufactured fertilizer. As such, and especially when manufactured fertilizer costs are high, there can be significant demand for PL. Poultry barns are typically located in the more rural areas of counties in the Clarksville BDO Zone supply basin. These areas are also where PL is most likely to be land-applied as a lower-cost substitute for manufactured fertilizer. For these reasons, competitors for PL in and around the Clarksville BDO Zone supply basin are likely located closer to where PL is produced than a bio-based facility would be if located in the Clarksville BDO Zone. Risk associated with competitor locations and geographical influence on the market is deemed to be very high. Raw RI Score is 9 out of 10.	**Score 9**
Notched Salience: PL is typically sold on the spot market, and its pricing is closely linked to the cost of fertilizer. Although PL is commonly utilized as a land-applied fertilizer, a bio-project could potentially obtain access to the majority of available PL by offering a more attractive price than the current market. Therefore, the price of PL will be a crucial factor in determining the allocation of PL between land application and other uses, such as bio-projects. Effectively, land application markets' competitive pressure can be effectively mitigated through a pricing strategy. As a result, Raw RI is notched by 25%: Notched Salience is 2.25.	**Score Notched 2.25**
Impact Level: While it is probable that a significant quantity of PL could be procured at a premium to current pricing, the long-term pricing trajectory is uncertain. In view of the dynamic nature of the market, the future price ceiling of PL is challenging to predict with a high degree of accuracy. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 22.48 out of 100.	**Score 22.48**

2.2. Historical Fluctuation of Quantity Used

Rationale: Clear understanding of key competitors' consumption of each type of feedstock utilized by the Proponent is essential to quantifying the risks associated with each competitor. Understanding historical trends of feedstock utilization can provide valuable information about feedstock price elasticity during shortages and insight into events that may impact future supply conditions. It can	

also enable more accurate estimates of the sensitivity of feedstock availability to potential future consumption levels or to the impact of external events (e.g., weather events, structural economic changes, seasonality, or policy change).	
Raw RI Score: No public information could be found pertaining to the historical use of PL as a fertilizer in the Clarksville BDO Zone supply basin. However, since PL is an unavoidable by-product of the poultry industry, and since the only current use for PL is land application, it is assumed that all PL produced in the Clarksville BDO Zone supply basin is land applied. The price of PL is heavily impacted by the price of manufactured fertilizer; when the price of fertilizer increases so does the price that PL can be sold for, and vice-versa. As such, while use of PL generated in the Clarksville BDO Zone supply basin isn't expected to change (i.e., all available PL will be land applied), the cost of acquiring it will fluctuate relative to the price of manufactured fertilizer (i.e., as fertilizer becomes more expensive, the price charged for PL will increase). Risk associated with historical fluctuation of quantity used is deemed to be moderate. Raw RI Score is 6 out of 10.	**Score 6**
Notched Salience: No adjustment.	**Score Unnotched 6.0**
Impact Level: The historical fluctuations in PL usage are of limited impact due to the fundamental nature of PL's production as a by-product of poultry operations, independent of its utilization. While the historical data on PL usage may be scarce, the inherent characteristics of the poultry industry indicate that the production of PL is an ongoing aspect of the industry, irrespective of its utilization. Consequently, the historical fluctuations in PL usage may have minimal bearing on the future supply of PL available to the market. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 19.98 out of 100.	**Score 19.98**

2.3. Competitor Pricing and Price Sensitivity

Rationale: Understanding how much competitors pay for different feedstock types is an essential step in determining competitiveness of Proponent. Historical prices paid by competitors provide insight into their procurement behaviors and ability/willingness to pay premiums for feedstock and exert pressure on Proponent's suppliers during times of feedstock shortage. Competitors who are able to offer higher prices for feedstock during feedstock shortages can pose significant risks to Proponent.

Raw RI Score: As previously noted, the cost of PL is heavily impacted by the price of manufactured fertilizer (as one increases/decreases, so does the other). However, due to multiple reasons (including inconsistency, low nutrient bulk density and odour) PL is seen as an inferior fertilizer product, and as such, the cost of PL is always lower than that of manufactured fertilizer.[6] Currently, and based on discussion with several industry experts, PL in the Clarksville BDO Zone supply basin costs between $30 - $40/ton (wet basis) delivered to site. This price, significantly higher than just a few years ago (when it was in the region of $10 - $20/ton, isn't expected to fall anytime soon because the price of manufactured fertilizers, due to surging input costs, supply disruptions and export restrictions, is expected to stay high (Figure 1, Appendix C). Risk associated with competitor pricing and price sensitivity is deemed to be very high. Raw RI Score is 9 out of 10.	**Score 9**
Notched Salience: The majority of PL purchase agreements in the Clarksville BDO Zone supply basin are of the "spot" or short-term variety, with long-term, fixed-price contracts being the exception. This creates an opportunity for potential buyers to secure PL supply below the prevailing spot market price of $30 - $40 per ton by offering long-term contracts to suppliers. Furthermore, the credit rating has been evaluated using a pricing range of $35-$45 per ton, which somewhat mitigates the risk of price sensitivity. By considering this pricing range and the potential for long-term contracts, buyers may be able to stabilize their supply costs while mitigating the risk of potential price volatility. As a result, Raw RI is notched by 50%: Notched Salience is 4.5.	**Score Notched 4.5**
Impact Level: As a result of the limited availability of PL pricing data, our analysis is primarily based on verbal feedback obtained from market participants. The lack of pricing data presents a challenge in assessing the historical correlation between the prices of synthetic fertilizers and PL. While synthetic fertilizers are often used as a benchmark for pricing PL, the precise relationship between the two is unclear. Therefore, our analysis is subject to a degree of uncertainty due to the reliance on non-quantitative feedback from market participants and limited historical pricing data. RI Impact Level is deemed ***high*.**	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 44.95 out of 100.	**Score 44.95**

2.4. Impacts of Future Demands on Feedstock Availability and Price

Rationale: Future competitors for feedstock, or expansion of feedstock demand by current competitors, can cause feedstock market disruption.

Even before new competitors become operational, high interest in a supply basin can make suppliers overconfident, leading to a supplier-controlled market where short-term contracting becomes the norm and supply chain reliability is compromised for the Proponent. Once operational, new competitors increase demand on feedstock, potentially lowering availability and increasing cost.

Existing competitors may seek to expand operations, increasing consumption of feedstock.

[6] A Southern Agricultural Economics Association study found that when cost approached the cost of manufactured fertilizer, market willingness to purchase PL dropped significantly.

Raw RI Score: PL is used as a low-cost substitute for manufactured fertilizer in the Clarksville BDO Zone supply basin. As such, and because the area of land used for agriculture in and around the Clarksville BDO Zone supply basin is expected to remain the same, future demand for PL is expected to remain fairly consistent. Furthermore, there are currently no known projects that have been announced or that are under construction that would consume PL in or near the Clarksville BDO Zone supply basin. Risk associated with impacts of future demand on feedstock availability and price is deemed to be low. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience: The majority of PL purchase agreements in the Clarksville BDO Zone supply basin are of the "spot" or short-term variety, with long-term, fixed-price contracts being the exception. This creates an opportunity for potential buyers to secure PL supply below the prevailing spot market price of $30 - $40 per ton by offering long-term contracts to suppliers. Also, the fact that the Clarksville BDO Zone has been rated at $35 - $45 per ton price level is a mitigator of future demand. As a result, Raw RI is notched by 75%: Notched Salience is 2.25.	**Score Notched 2.25**
Impact Level: A substantial increase in demand for PL would have a significant impact on the availability and pricing of PL. RI Impact Level is deemed high.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 22.48 out of 100.	**Score 22.48**

2.5. Supply Influence of Competitor

Rationale: In some cases, competitors may be able to exert high degrees of pressure on local suppliers, effectively enabling them to control feedstock, especially during periods of shortage. This control can derive from long previous relationships between suppliers and competitors, from verbal or "understood" agreements, or from a competitor being able to assist suppliers in times of surplus by maintaining large inventories that enable suppliers to continue supplying when other markets impose quotas. Understanding and planning around such soft risk factors is important. If such relationships exist in the Proponent's procurement area, they may indicate increased risk of feedstock shortage or pricing changes.	
Raw RI Score: Most agreements to purchase PL in the Clarksville BDO Zone supply basin are either "spot" or short-term contracts, with longer-term, fixed-price supply contracts being the exception. The reason for this is that the cost of PL fluctuates according to the cost of manufactured fertilizer, and as such, most users of PL don't want to tie themselves down to long-term contracts. Therefore, despite some poultry producers indicating a willingness to supplying a small amount of their PL to neighbors and other long-term users (even if a better offer were made), most would supply it to whomever offers the most attractive terms. Risk associated with supply influence of competitors is deemed to be low. Raw RI Score is 3 out of 10.	**Score 3**

Notched Salience: The majority of PL purchase agreements in the Clarksville BDO Zone supply basin are of the "spot" or short-term variety, with long-term, fixed-price contracts being the exception. This creates an opportunity for potential buyers to secure PL supply below the prevailing spot market price of $30 - $40 per ton by offering long-term contracts to suppliers. Also, the fact that the Clarksville BDO Zone has been rated at $35 - $45 per ton price level is a mitigator of future demand. As a result, Raw RI is notched by 75%: Notched Salience is 2.25.	**Score Notched 2.25**
Impact Level: In some instances, preexisting long-term relationships between poultry producers and farms may exist in the BDO Zone. However, given the significant number of poultry producers in the region, it is unlikely that such relationships would have a material impact on the supply chain. RI Impact Level is deemed low**.**	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 7.49 out of 100.	**Score 7.49**

2.6. Temporary Market-Driven Markets

Rationale: Alternative, non-traditional, market-driven competitors for feedstock can increase feedstock demand in unusual circumstances.	
Raw RI Score: There are currently no non-traditional, market-driven markets for PL in the Clarksville BDO Zone supply basin. The likelihood of such markets emerging are low. Risk associated with temporary market-driven markets is deemed to be very low. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score Unnotched 1.0**
Impact Level: The certainty regarding the absence of temporary markets is high. RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

2.7. Relative Accessibility/Delivery Hours & Wait Times

Rationale: The value attributed by suppliers to local markets can be directly related to the degree of flexibility the market provides in terms of delivery hours, and the more efficiently discharge can occur.	
Raw RI Score: The land application market offers a flexible off-loading opportunity for poultry producers in the Clarksville BDO Zone supply basin. The delivery hours are typically flexible, and wait times are minimal, which enhances the competitiveness of the land application market compared to alternative off-loading options. This flexibility provides poultry producers with greater convenience and control over their waste management processes and ensures a reliable and efficient means of disposing of PL. By contrast, projects that have limited accessibility or constrained delivery options may face challenges in securing a reliable supply of PL, which may impact their competitiveness. Risk associated with relative accessibility/delivery hours and wait times is deemed to be very *moderate*. Raw RI Score is 6 out of 10.	**Score 6**

Notched Salience: A potential bio-project can mitigate this risk indicator by ensuring flexible off-loading opportunity and delivery options. As a result, Raw RI is notched by 50%: Notched Salience is 3.0.	**Score Unnotched 3.0**
Impact Level: PL is a nuisance by-product for poultry producers that must be disposed of promptly. Due to the time-sensitive nature of PL disposal, suppliers may place a higher value on the flexibility of off-loading than the marginal profit they make from selling the product. The priority of poultry producers is to dispose of PL quickly and efficiently, and therefore they may be willing to accept a lower price for PL to secure a reliable and convenient means of disposal. RI Impact Level is deemed *high.*	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 29.97 out of 100.	**Score 29.97**

2.8. Relative Specification Advantages

Rationale: When choosing a market, suppliers not only look at price, but also at relative quality requirements or specifications. It is important to understand a competitor's feedstock quality specifications in order to accurately quantify the risk that a competitor can exert on the Proponent's supply chain.	
Raw RI Score: Poultry production takes place within highly monitored, climate-controlled barns, where the raising of broilers is typically standardized. As a result, the potential for significant variations in the characteristics of PL, beyond its nutrient content, is typically low. Although some farmers may require lab testing to determine the nutrient content of PL, most farmers receive PL under an "as is, where is" arrangement, without any testing. This indicates that farmers have a high tolerance for PL quality, which may reduce the incentive for PL producers to improve its quality. Therefore, a new bio-project that relies on PL as a key input would need to have a high level of tolerance for the potential variability in PL quality. PL quality variation becomes a risk. The ability of a project to accommodate such variability in PL quality may be instrumental in ensuring the long-term success and sustainability of the project. Risk associated with relative specification advantages is deemed to be medium. Raw RI Score is 6 out of 10.	**Score 6**
Notched Salience: This RI can be mitigated by ensuring a high-degree of PL quality tolerance. No adjustment. As a result, Raw RI is notched by 25%: Notched Salience is 1.5.	**Score Notched 1.5**
Impact Level: The ability of farmers to accept PL of any quality may provide a significant competitive advantage in the market for PL. RI Impact Leve is deemed *high.*	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 14.98 out of 100.	**Score 14.98**

CATEGORY 3: SUPPLY CHAIN RISK

3.1. Feedstock Availability

Rationale: Biomass Availability Multiple (BAM) indicates the degree of redundancy in a Proponent's supply chain. BAM is the ratio of biomass feedstock available to a project, at costs, timing, and in quality feasible for the Proponent, divided by the project's feedstock requirements. BAM is a strong indicator of supply chain resilience when stressed by supply shortage and/or supplier breach.	
Raw RI Score: Poultry manure (PM) and poultry litter (PL) are direct by-products of the poultry industry. PM consists mainly of excrement produced by egg laying birds (called layers) that are kept on raised floors or in cages suspended above the floor. PL is a mixture of excrement, bedding material and waste feed from chickens (called broilers) and turkeys raised on barn floors for their meat. For these reasons, PM and PL are quite different. Over 2.4 million tpy of PL (1.9 million from broilers and 0.5 million from turkeys) is generated within the Clarksville BDO Zone. If a new bio-based facility were to require 150,000 tpy of PL (a facility using this amount of PL would be considered average by industry standards)[7], the coverage ratio or BAM would be 16 the facility's intake requirements, which is very high. Risk associated with BAM is deemed to be very low. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score Unnotched 1.0**
Impact Level: The availability of PL is the basis for this assessment. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99 out of 100.	**Score 9.99**

3.2. Impact of Increased Utilization of Feedstock

Rationale: Feedstock utilization in the supply basin can change over time. Existing consumers of feedstock can expand operations or new facilities can enter the market. Increased utilization puts additional pressure on feedstock and can lead to higher prices, feedstock disruptions, shortages, or supplier breach.	
Raw RI Score: Farmers use PL as a low-cost substitute for manufactured fertilizer. Because land availability is relatively fixed within the Clarksville BDO Zone supply basin, the demand for PL as a fertilizer isn't expected to increase significantly. There are also no other known uses for PL in and around the Clarksville BDO Zone supply basin. Furthermore, while the number of broilers produced in Arkansas hasn't changed much over the past decade, production (as measured by pounds of meat) has increased by more than 27% from 2011 to 2021[8]. This increase, which has resulted in increased supply of PL (as larger birds require more bedding and excrete more manure), is expected to continue.	**Score** 1

7 Delaware Business Times: https://delawarebusinesstimes.com/news/new-partnership/.
8 USDA Arkansas Field Office:
www.nass.usda.gov/Statistics_by_State/Arkansas/Publications/Livestock_Releases/Production_and_Value/arbroilerPV.pdf

Risk associated with risk of increased utilization of feedstock is deemed to be low. Raw RI Score is 1 out of 10.	
Notched Salience: No adjustment.	**Score Unnotched 1.0**
Impact Level: We are certain that there is a low likelihood of increased PL utilization, especially as compared to the increased production. That being said, significant increases in demand for PL can materially affect the supply chain. RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

3.3. Feedstock Supply Curve

Rationale: The greater the feasible transport distance, the more feedstock is accessible to the Proponent, but at a higher delivered cost. The feedstock supply curve is a function of feedstock availability over its cost, which is primarily, but not exclusively, a function of distance. The feedstock supply curve is used to determine the availability of redundant feedstock at various price points.	
Raw RI Score: Although point data on the locations of poultry producers and associated PL production estimates were unavailable, our analysis suggests that the distribution of poultry houses is relatively even throughout the BDO Zone. As a result, we anticipate that significant quantities of PL will be generated in close proximity to each other, with production increasing exponentially as the distance from the poultry houses increases. This suggests that additional quantities of PL will be available at marginally higher prices as the distance from the poultry houses increases. Risk associated with feedstock supply curve is deemed to be moderate. Raw RI Score is 5 out of 10.	**Score 5**
Notched Salience: The feedstock supply curve suggests that there is an additional availability of feedstock as the transport costs increase. The credit rating for the Clarksville BDO Zone has been assessed based on a pricing range of $35 - $45 per ton, which includes the additional transport costs necessary to de-risk the supply chain. As a result, Raw RI is notched by 25%: Notched Salience is 1.25.	**Score Unnotched 1.25**
Impact Level: While a new bio-project is expected to have access to significant quantities of PL at marginal additional transport cost, the lack of data regarding the detailed locations of poultry producers and the associated volume of poultry generated at each facility introduces the risk of uncertainty. RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 8.32 out of 100.	**Score 8.32**

3.4. Seasonal Feedstock Supply Variation

Rationale: Biomass supply can present significant seasonal supply variations. Seasonal supply variations combined with limitations associated with longer-distance transportation and storage can lead to regional biomass supply imbalances and can manifest in shortages and higher costs for Proponents.	
Raw RI Score: Poultry production, and thereby the generation of PL, occurs year-round. Furthermore, poultry producers clean-out their barns at different times of the year; meaning that due to the number of poultry producers in the Clarksville BDO Zone supply basin, it is highly-likely that a consistent supply of PL is available year-round and there is no seasonal supply variation.	**Score 1**

Risk associated with seasonal feedstock supply variation is deemed to be very low. Raw RI Score is 1 out of 10.

Notched Salience: No adjustment.	**Score** **Unnotched** **1.0**
Impact Level: We are fairly certain that the seasonal variability in PL production is low. That being said, the impact to the supply-chain of such variation would be significant. RI Impact level is deemed *moderate*.	**Score** **6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score** **6.66**

3.5. Year-to-Year Variation in Feedstock Availability

Rationale: Biomass can have significant year-to-year supply variations due varying production cycles.

Raw RI Score: PL is an unavoidable by-product of the poultry industry. The past decade clearly shows that the poultry industry in Arkansas is stable and growing. Furthermore, poultry production occurs inside highly-monitored, climate-controlled barns, where the practice of raising broilers is highly standardized. As such, no significant year-to-year variations in PL availability is anticipated. Risk associated with year-to-year variations in feedstock availability is deemed to be very low. Raw RI Score is 1 out of 10.	**Score** **1**
Notched Salience: No adjustment.	**Score** **Unnotched** **1.0**
Impact Level: We are fairly certain that the year-to-year variability in PL production is low. That being said, the impact to the supply-chain of such variation would be significant. RI Impact Level is deemed *moderate.*	**Score** **6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score** **6.66**

3.6. Front-End Validation of Data Used in Feedstock Availability Models

Rationale: Feedstock supply models can be complex. Lack of clarity about model assumptions and baseline data can result in confusion on the part of the capital markets and drive financing costs for biomass projects. The adequacy and credibility of assumptions and baseline data is paramount to credible model outputs.

Raw RI Score: PL generation and manufactured fertilizer cost data is rare and mostly incomplete. The most recent available estimates on poultry production (and thereby PL generation) are from 2017, and lack nuance and granularity. Furthermore, most PL pricing data is based on direct feedback from poultry producers, PL brokers, transportation companies and industry experts. While every effort was made to find third-party validated data, this was not possible in most cases. Risk associated with front-end validation of data used in feedstock availability models is deemed to be moderate. Raw RI Score is 5 out of 10.	**Score** **5**

Notched Salience: The risk associated with the Clarksville BDO Zone rating is mitigated by the significant redundancy in the PL supply. Our analysis indicates that approximately 2.4 million tons per year (tpy) of PL is generated in the BDO Zone, while the rating is issued for 150,000 tpy, resulting in a redundancy of 16x. This high level of redundancy is expected to mitigate the risks associated with incomplete or inaccurate data regarding the supply and cost of PL in the BDO Zone. As a result, Raw RI is notched by 25%: Notched Salience is 1.25.	**Score 1.25**
Impact Level: Because feedstock availability estimates are all based on available data and models, RI Impact Level is deemed *high.*	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 12.49 out of 100.	**Score 12.49**

3.7. Historical Feedstock Price Variations and "Red-Line" Feedstock Cost

Rationale: If volatility is shown in the historical feedstock price, then the risk of future price fluctuation is elevated. If feedstock prices have historically exceeded the price at which the Proponent would have to cease operations or breach a financial covenant (i.e., the "red-line" feedstock cost), then mitigation measures should be put in place.	
Raw RI Score: The cost of manufactured fertilizer cannot be directly compared to PL on a per-ton basis. One reason for this is that a ton of, for example, Urea 44 - 66% nitrogen has 10 – 20 times more nitrogen than a ton of PL. Another reason direct comparison cannot be made is that manufactured fertilizer has precise nutrient content (e.g., levels of nitrogen, phosphate or potassium), and can be mixed to precisely meet crop needs. PL has variable nutrients levels, making it much harder to match with crop needs. Nonetheless, the cost of PL does loosely track the cost of manufactured fertilizer; as manufactured fertilizer increases or decrease in price, so does PL. Between 2014 – 2020, the price of manufactured fertilizers remained fairly consistent. However, since 2021 manufactured fertilizer costs have skyrocketed; increasing 80% in 2021 and 30% in 2022 (Figure 1, Appendix C). These price increases have been caused by a variety of factors, including 'surging input costs, supply disruptions caused by sanctions (Belarus and Russia), and export restrictions (China)', all of which have been amplified by the war in Ukraine'. While these factors may be considered a perfect storm, they underline the potential price risk of PL over the long-term. Risk associated with historical feedstock price variations and "red-line" feedstock cost is deemed to be moderate. Raw RI Score is 5 out of 10.	**Score 5**
Notched Salience: PL price fluctuations could be mitigated somewhat by entering into fixed-price, long-term supply contracts. However, it is currently unknown how many poultry producers would enter into such lower-price contracts. As a result, the score is not notched.	**Score 5.0**
Impact Level: Currently, all PL generated in the Clarksville BDO Zone is land-applied as a fertilizer. The price of PL is closely correlated with that of fertilizer, and an increase in the price of fertilizer would likely result in an increase in the price of PL. This relationship between PL and fertilizer prices is significant to the PL supply chain. RI Impact Level is deemed *high.*	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 49.95 out of 100.	**Score 49.95**

3.8. Low Historical Demand for Feedstock in the Supply Basin

Rationale: If Proponent supply basin does not have history of developed, large-scale feedstock procurement, suppliers may not have sufficient expertise in feedstock production to ensure reliable supply, especially in early years.	
Raw RI Score: Historical demand for PL in the Clarksville BDO Zone supply basin is deemed to be relatively strong, as it has been widely used as a fertilizer for many years. The poultry industry is also well established, while the process of raising poultry is consistent and highly unlikely to change much. Finally, the infrastructure for PL collection and delivery is deemed to be mature and robust. Risk associated with low historical demand for feedstock in the supply basin is deemed to be low. Raw RI Score is 1 out of 10.	**Score** 1
Notched Salience: No adjustment.	**Score Unnotched 1.0**
Impact Level: RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.9. History of Production/Feedstock is a Secondary Crop or a Byproduct

Rationale: If feedstock is a new/secondary crop or a by-product, suppliers may either lack sufficient experience to mitigate risk, or be unable to react to such risk. Secondary crop or by-product producers may be less likely to prioritize production. If feedstock is a secondary crop, then production can be subject to variables beyond suppliers' control (e.g., changing primary crop prices).	
Raw RI Score: PL is a by-product of the poultry industry. Poultry production in the region is well-established, and has steadily increased since 2009. Furthermore, many PL producers are expanding their operations on the assumption that this growth will continue. These trends indicate that the production of PL in the Clarksville BDO Zone supply basin should remain stable, and may even grow. Risk associated with the history of production/feedstock is a secondary crop or a by-product is deemed to be low. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score Unnotched 1.0**
Impact Level: RI Impact Level is deemed low.	**Score 3.33**
Loaded RI Score: (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.10. Fuel Prices

Rationale: Diesel, oil and PPI can impact feedstock cost over time.	
Raw RI Score: Diesel prices in the region have fluctuated from $1.12 - $5.39/gallon over the past two decades (Figure 2, Appendix C). Recent price increases in diesel over the past few years (2021 and	**Score 3**

2022) are not expected to continue, although prices may remain high. However, diesel only makes up a small portion of the cost of PL. For example, for a 25-ton load of PL being transported 35 miles (70 miles return-trip), and assuming diesel consumption of 8 miles/gallon, an increased diesel cost of $1/gallon would only increase the cost of delivering PL by $0.53/ton.

Risk associated with fuel prices is deemed to be moderate to low. Raw RI Score is 3 out of 10.

Notched Salience: No adjustment.	**Score Unnotched 3.0**
Impact Level: While diesel prices may be subject to volatility, the impact of changes in diesel prices on the PL supply chain risk is expected to be limited. Our analysis indicates that diesel prices account for only a small portion of the overall cost of PL, and as such, changes in diesel prices are not expected to have a significant impact on the viability of projects that rely on PL. RI Impact Level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 19.98 out of 100.	**Score 19.98**

3.11. Collection Practices & Schedules

Rationale: Differences in collection timing and practices used can create risk to both the quantity and quality of feedstock.

Raw RI Score: Poultry producers clean-out their barns at different intervals and at different times of the year. Therefore, due to the large number of poultry producers in the Clarksville BDO Zone supply basin, there is a high likelihood PL will be available year-round. Furthermore, poultry production occurs inside highly-monitored, climate-controlled barns, where the practice of raising birds is highly standardized. Risk associated with harvest and collection practices and schedules is deemed to be low. Raw RI is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score Unnotched 1.0**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.12. Collection Equipment

Rationale: Different types of collection equipment used by suppliers can have a significant impact on the quality and availability of feedstock. Use of different types and combinations of collection and processing equipment among suppliers can lead to non-homogeneous feedstock.

Raw RI Score: The process of cleaning PL from barns is fairly standard, while transportation of PL is predominantly performed by established third-party trucking companies who own the necessary vehicles.	**Score 1**

Risk associated with harvesting and collection equipment is deemed to be low. Raw RI Score is 1 out of 10.	
Notched Salience: No adjustment.	**Score Unnotched 1.0**
Impact Level: RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.13. Temporary Externality-Driven Markets for Feedstock

Rationale: Alternative, non-traditional, externality-driven competitors for feedstock can drive feedstock demand (and cost) in unusual circumstances.	
Raw RI Score: PL is a by-product from PL production. Its use as a fertilizer, which is driven by its nutrient content and the cost of manufactured fertilizer, is well established. Aside from being used as a feedstock for new bio-based facilities, there are currently no know alternative uses or non-traditional competitors for this feedstock in the Clarksville BDO Zone supply basin. Risk associated with temporary externality-driven markets for feedstock is deemed to be low. Raw RI is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score Unnotched 1.0**
Impact Level: RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.14. Variations in Densification Methods Among Different Suppliers

Rationale: The shape and density of the unit in which feedstock is supplied can impact feedstock cost and quality.	
Raw RI Score: Poultry production occurs inside highly-monitored, climate-controlled barns, where the practice of raising birds is highly standardized. For these reasons, PL for a specific barn is fairly homogenous year-round. However, differences in PL can occur between poultry producers, and is typically a result of the bedding material used, and/or how often PL is removed from barns. For example, while some PL in the Clarksville BDO Zone supply basin use wood shavings for bedding material, others use rice hulls. Furthermore, some poultry producers remove PL from their barns after each production cycle, following an "all in, all out" philosophy, while others remove it once or twice a year, or even once every few years. Risk associated with variation in densification methods among different suppliers is deemed to be moderate. Raw RI is 5 out of 10.	**Score 5**

Notched Salience: While it may be difficult to get poultry producers to change the type of bedding material they use, long-term PL contracts at an attractive price could incentivize poultry producers in the Clarksville BDO Zone supply basin to remove PL from their barns after a set amount of time, thereby ensuring some level of consistency. Additionally, the large quantity of PL produced in the BDO Zone allows for choosing sources with the highest quality of PL. As a result, Raw RI is notched by 50%: Notched Salience is 2.5.	**Score Notched 2.5**
Impact Level: There is a level of uncertainty related to variations in feedstock quality among different suppliers. Specifically, the type of bedding typically used by each poultry producers were not available. That being said, due to the large number of poultry producers, the impact of this RI is limited. RI Impact Level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 16.65 out of 100.	**Score 16.65**

3.15. Availability of Labor for Feedstock Production

Rationale: Skilled labor shortages can be difficult to remedy in the short term. Availability of suitable labor in an area can impact the ability to procure sufficient feedstock quantities on schedule. Labor risks are higher for facilities where supply chains are not yet active; or for Proponent's for whom large feedstock requirements, or development of new (or expanded) supply chains, demand significant additions to the local labor force.	
Raw RI Score: Large-scale poultry producers have been operating in the Clarksville BDO Zone supply basin for decades,[9] and poultry production in Arkansas is growing; feedback from local poultry producers indicated that many are planning to expand their operations to meet increasing demand. Furthermore, the practice of raising birds is highly standardized and required skill-level of typical poultry workers is fairly low. The risk of availability of labor for feedstock production is deemed to be low. Raw RI is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score Unnotched 1.0**
Impact Level: Other than transportation, PL production does not require additional labor. RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.16. Feedstock Transportation Costs

Rationale: Transportation can be one of the most significant cost components of biomass supply chains. The average transportation cost and percentage of total feedstock cost attributable to transportation should be known.	
Raw RI Score: Raw RI Score. PL transport within the Clarksville BDO Zone supply basin is typically done by third-party haulers using walking-floor trailers. Average payload weight for PL transportation is 23-25 tons, and transportation costs $8 - $10/ton for deliveries < 30 miles ($184 - $250 trailer). For	**Score 4**

[9] Central Arkansas Library System. Poultry Industry. Encyclopedia of Arkansas. https://encyclopediaofarkansas.net/entries/poultry-industry-2102/

deliveries beyond 30 miles, cost is approximately $6/mile/trailer. These costs are relatively similar to transportation costs elsewhere.

The cost/tonne of PL in the Clarksville BDO Zone supply basin is estimated to be $30 - $40/ton. As such, transportation costs account for approximately 25% of total cost. Transportation costs are increasing due to rising prices for diesel, equipment, labour, etc. However, because this upward pressure is being felt across almost all industries (including fertilizer manufacturing), any increase in transportation costs will likely not result in an increased percentage of total feedstock cost attributable to transportation.

Risk associated with feedstock transportation costs is deemed to be moderate. Raw RI Score is 4 out of 10.

Notched Salience: No adjustment.	**Score Unnotched 4.0**
Impact Level: The impact of transport cost is limited by the large quantity of PL generated in the BDO Zone. A new bio-project should be able to source most of its feedstock from relatively short distances. RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 13.32 out of 100.	**Score 13.32**

3.17. Transportation Distances

Rationale: Average transport distances of 40-50 miles for biomass feedstocks are typical but larger distances can be common. That being said, the average transport distance for PL should be below 30 miles. Where average transport distance from suppliers to Proponent is high, the supply chain is subject to greater sensitivities to risks, such as increases in diesel cost, weather impacts, mechanical breakdown, and by the demand for feedstock from competitors closer to the source.

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

Raw RI Score: The Clarksville BDO Zone supply basin is 75 miles. Within this area, an estimated 2.4 million tpy of PL is generated by approximately 3,550 barns. If PL availability is assumed to be somewhat uniformly available throughout the supply basin (a fair assumption based on that 1/3 of poultry barns are located within 35 miles of the Clarksville BDO Zone), approximately half of this (1.2 million tpy) would be generated within 50 miles of Clarksville. If a new bio-based facility were to require 150,000 tpy of PL, the coverage ratio or BAM would be 8 times the facility's intake requirements, which is high. Risk associated with transportation distance is deemed to be low. Raw RI is 3 out of 10.	**Score 3**
Notched Salience: No adjustment.	**Score Unnotched 3.0**
Impact Level: The impact of transport cost is limited by the large quantity of PL generated in the BDO Zone. A new bio-project should be able to source most of its feedstock from relatively short distances. RI Impact Level is deemed low.	**Score 3.33**

Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99 out of 100.	**Score 9.99**

3.18. Transportation of Feedstock Requires Specialized Equipment

Rationale: Requirements for specialized transport equipment can increase supply chain risk. Where there is low availability in required transportation equipment, equipment owners have increased leverage over transportation prices and supply chain resiliency can be lower.	
Raw RI Score: PL transport within the Clarksville BDO Zone supply basin is typically done by third-party haulers using walking-floor trailers. While these trailers are semi-specialized equipment and relatively expensive, PL transportation is a well-established industry with multiple companies offering their services. As such, while the barriers to entry may be challenging, the leverage transportation companies have over transportation prices is relatively low and the supply chain is deemed to be resilient. Risk associated with transportation of feedstock requires specialized equipment is deemed to be low. Raw RI is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score Unnotched 2.0**
Impact Level: Because PL is currently being moved across the BDO Zones, we are confident about the access to walking-floor trailers. RI Impact Level is deemed low.	**Score 3.33**
Loaded RI Score Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

3.19. Delivery Routes through Local Communities

Rationale: Transportation of biomass can become a nuisance to local communities, especially if a large number of trucks pass through residential and school areas. Local communities often have power to force regulations regarding truck transport, impeding a Proponent's ability to transport feedstock. This risk is greater in **greenfield projects** than operational ones.	
Raw RI Score: PL odor can be noticeable and unpleasant during transportation. However, there are major transportation routes into and around Clarksville BDO Zone, thereby enabling PL trucks to avoid potentially sensitive areas. Furthermore, not only is the poultry sector one of the largest employers in the area, but there is a long track record of PL transportation in the region. Finally, PL is already being moved across Clarksville BDO Zone, therefore local communities are used to any nuisance related to that. Risk associated with delivery routes through local communities is deemed to be low. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score Unnotched 2.0**
Impact Level: A new bio-project would not introduce additional nuisance related to transport of PL. RI Impact Level is deemed *low.*	**Score 3.33**

Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

3.20. Road Infrastructure

Rationale: Feedstock cost and availability can be a function of the accessibility of road infrastructure**.** Problems with road networks will translate directly to risks to feedstock supply.	
Raw RI Score: Road infrastructure is well-developed in and around Clarksville BDO Zone. This infrastructure is expected to easily support the truck weights and transport frequency of PL being delivered to a new bio-based facility. Risk associated with road infrastructure is deemed to be low. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score Unnotched 2.0**
Impact Level: In an event that road infrastructure is not fully adequate to the needs of a new bio-project, the impact to the supply chain could be felt**.** Impact Level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 13.32 out of 100.	**Score 13.32**

3.21. Number, Size, Mix, & Locations of Suppliers

Rationale: In general, a supply portfolio involving multiple suppliers of various sizes is important for ensuring steady and uninterrupted feedstock supply with minimal price fluctuations. If a small number of large suppliers provides a high proportion of total feedstock, a disruption or supplier breach will have greater impact on the supply chain. In such cases the risk of disruption is lower but the impact of those disruptions is higher. Conversely, a large number of small suppliers are less likely to have the capacity to withstand internal disruptions and thus may be more likely to breach. Here, risk of disruption is higher but their likely impact is lower. The number of suppliers as well as the ratio of small to large suppliers should be optimized. There is no pre-determined number or optimal ratio of suppliers, although having too many or too few can both pose higher degrees of risk.	
Raw RI Score: It is estimated that PL is generated by approximately 3,550 barns spread throughout the Clarksville BDO Zone supply basin**.** While the size of each barn is unknown, data from the 2017 USDA Census of Agriculture[10] shows that 11% of these barns produce 100,000 - 199,999 broilers, 13% produce 200,000 - 299,999 broilers, 28% produce 300,000 - 499,999 broilers, and 40% produce 500,000 broilers or more. This data suggests there are multiple sources of PL from various sized barns in the Clarksville BDO Zone supply basin. Risk associated with the number, size mix and locations of suppliers is deemed to be low. Raw RI Score is 1 out of 10.	**Score 1**

[10] Volume 1, Chapter 1: Arkansas. Table 30. Poultry - Inventory and Number Sold
www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_1_State_Level/Arkansas/st05_1_0030_0031.pdf

Notched Salience: No adjustment.	**Score Unnotched 1.0**
Impact Level: There is a degree of uncertainty with regards to the barn size data due to the fact that is aggregated at the county level. That being said, the impact of barn size to the PL supply chain risk is limited. RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.22. Suppliers Subject to Same External Risk Factors (Non-Weather & Equipment Based)

Rationale: When a single risk event can impact the feedstock production ability of all (or most) suppliers, then feedstock risk is higher and supply chain resiliency is lower. Resilience is maximized when biomass supply chains exhibit diversity in their locations, production practices, and other elements of supply chain structure such that the impact of single, high-risk events have varying impacts on suppliers.	
Raw RI Score: Poultry producers in the Clarksville BDO Zone are all subject to the same external risk factors. These factors, which include diseases that could kill birds, and being under contract to a small handful of processing companies, could cause major disruptions to broiler supply/demand (and therefore PL production). However, poultry production occurs inside highly-monitored, climate-controlled barns, where biosecurity procedures and protocols are taken very seriously. Also, demand for poultry in Arkansas is robust; as is evident in continual increased production from 2011 to 2021.[11] Risk associated with suppliers subject to same external risk factors is deemed to be low. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: The risk associated with suppliers being subject to the same external risk factor is further mitigated by the large volume of generated PL relative to the quantity this BDO Zone is scored for, with the redundancy being 16x. RI is notched by 50%, resulting in a score of 1.0.	**Score Notched 1.0**
Impact Level: In case of a large event affecting most poultry producers, the impact to the supply chain would be significant. Impact level is deemed *high.*	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99 out of 100.	**Score 9.99**

3.23. Long-Term Weather and Climate Trends

Rationale: In certain regions, climate trends and significant potential changes to future weather patterns can create feedstock risk.	
Raw RI Score: Poultry production occurs inside highly-monitored, climate-controlled barns. For this reason, poultry production (and consequently PL supply) is highly unlikely to be impacted by climatic trends and potential weather patterns changes in the Clarksville BDO Zone supply basin. Risk associated with long-term weather and climate trends is deemed to be low.	**Score 1**

[11] USDA Arkansas Field Office: www.nass.usda.gov/Statistics_by_State/Arkansas/Publications/Livestock_Releases/Production_and_Value/arbroilerPV.pdf

Raw RI Score is 1 out of 10.	
Notched Salience: No adjustment.	**Score Unnotched 1.0**
Impact Level: RI Impact Level is deemed low.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.24. Local, Provincial, & National Laws, Regulations, & Permitting Pertaining to Biomass

Rationale: Feedstock production that is directly dependent on local, provincial, or national laws or government regulations can pose greater long-term risk than feedstock that is not, since laws and regulations may be subject to amendment or repeal. If utilization of biomass requires specific permits (e.g., percentage removal of forest residues or corn stover, allowable cut limits**,** air emission, storage permits, rights-of-way, overweight permits for trucks, cross-border permitting for shipment of biomass, chain of custody, or certification of sustainability), the likelihood of obtaining such permits and/or complying with permitting requirements should be examined.	
Raw RI Score: Nutrient runoff and phosphorus loading of local watersheds due to land-application of PL is a major political issue in Arkansas. If new regulations that severely restrict PL land-application are passed, poultry producers could consider re-locating elsewhere. However, the importance of the poultry industry to the regional economy (poultry is Arkansas' leading agricultural industry[12]), the high cost of relocating poultry barns, and the challenge in finding other locations that have the same level of skilled workforce and processing infrastructure, suggests this is highly unlikely to occur. In fact, any new regulations severely restricting PL land-application would significantly lower the price of PL as it would have to move large distances to find a disposal market. Therefore, new regulations would likely be favorable to a new bio-project. Risk associated with local, provincial, and national laws, regulations, and permitting pertaining to biomass is deemed to be low. Raw RI Score is 2 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score Unnotched 1.0**
Impact Level: RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

[12] Farm Bureau Arkansas Poultry: www.arfb.com/pages/arkansas-agriculture/commodity-corner/poultry/

3.25. Backlash Against Biomass Development, Procurement or Usage in the Region

Rationale: Public backlash against biomass development in the Proponent region can directly impact Proponent's ability to procure, transport, trans-load, store, or utilize feedstock by affecting local policies, regulations, and Proponent's ability to obtain necessary permitting.	
Raw RI Score: Anecdotal feedback from poultry producers in the Clarksville BDO Zone suggests that a new bio-based facility would be widely accepted. The reason for this is that it would increase demand, and therefore potentially the price, of PL. For those that land-apply PL, a new bio-based facility might not be so widely accepted (for exactly the same reasons). The ability of these individuals to impact a new bio-based facility's ability to source PL is unknown. Risk associated with backlash against biomass development, procurement or usage in the region is deemed to be low. Raw RI Score is 3 out of 10.	**Score 5**
Notched Salience: The risk of backlash from farmers currently land-applying PL is mitigated by the fact that this BDO Zone is rated for 1/16th of the generated quantity of PL. In other words, a new bio-project consuming 150,000 tpy of PL would still leave over 2.2 million tpy of PL available to the farmers. That being said, the perception of a new bio-project influencing the market for PL may still be significant. We notched the Raw RI by 50%, resulting in a score of 2.5.	**Score Notched 2.5**
Impact Level: The degree to which farmers may oppose a new bio-project is unknown as it does not have a precedence in the area. That being said, we do not expect significant backlash. RI Impact Level is deemed *moderate.*	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 16.65 out of 100.	**Score 16.65**

3.26. Feedstock Sustainability, Including Risks to Soil Quality, & Surface & Groundwaters

Rationale: Public concerns about sustainability of feedstock production can jeopardize biomass feedstock operations. Sustainability certification schemes should be utilized where applicable to ensure that feedstock comes from sustainable sources. Soil sustainability can be defined as management of soil in a way that does not exert any negative or irreparable effects either on the soil itself or any other systems. There is a diversity of approaches to soil sustainability in jurisdictional guidelines for biomass harvesting and production. For different feedstock types, there are also different thresholds at which feedstock removal causes significant negative consequences on soil. Excessive nutrient runoff from biomass feedstock production can accumulate in surface waters and result in algal blooms and hypoxia which can lead to habitat loss for aquatic species higher up the food chain and alter aquatic ecosystem food webs. Damage to aquatic ecosystems can cause social and regulatory backlash. Water intake issues can also increase risk.	
Raw RI Score: PL isn't produced as a biomass feedstock. Instead, it is an unavoidable by-product of poultry production. Additionally, the current use of PL as fertilizer is likely more detrimental to the environment than a feedstock for a potential bio-project. Risk associated with feedstock sustainability, including risks to soil quality and surface and groundwaters is deemed to be low. Raw RI Score is 1 out of 10.	**Score 1**

Notched Salience: No adjustment.	**Score Unnotched 1.0**
Impact Level: We are confident that the impact of a new bio-project to the environment would be positive, as current uses of PL can be problematic. RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.27. GHG Emissions from Production, Harvest, & Transport

Rationale: Understanding a project's overall emissions and the carbon intensity throughout the feedstock supply chain is an essential part of reducing risks related to carbon pricing mechanisms and related regulations GHG emissions from production and transportation can be a significant challenge to Proponent claims of carbon neutrality for biomass projects. Carbon emissions from harvested soils, as well as emissions from delivery trucks, can make the achievement of net-zero GHG emissions difficult. If a Proponent's financial model relies on carbon neutrality/GHG regulatory pricing frameworks, then an investigation into the feedstock's carbon emission status is essential.	
Raw RI Score: PL is an unavoidable by-product of poultry production that accumulates within barns, after which it is removed and land applied. The production and harvesting of PL therefore create very minimal GHG emissions. PL is most-often transported via live-bottom or walking-floor trailers. While transportation creates GHG emissions, the Clarksville BDO Zone supply basin is relatively small. As such, any GHG emissions from transportation should be relatively small.[13] Risk associated with GHG emissions from production, harvest and transport of feedstock is deemed to be low. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score Unnotched 2.0**
Impact Level: RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

3.28. Geographic Location Influence on Feedstock Variability

Rationale: Feedstock from different regions may differ in quality.	
Raw RI Score: PL from within the Clarksville BDO Zone supply basin is produced within the same geographic region. Risk associated with geographic location influence on feedstock variability is deemed to be low. Raw RI Score is 1 out of 10.	**Score 1**

[13] Ultimately, the impact of transportation GHG emissions depends upon use of the PL. If PL is used to produce a product that offsets a large amount of GHG emissions, the impact of transportation will be negligible. However, if PL is used to produce a product that doesn't offsets a large amount of GHG emissions, the impact could be more significant.

Notched Salience: No adjustment.	**Score Unnotched 1.0**
Impact Level: Even if the Clarksville BDO Zone were located across different regions, large-scale poultry production tends to be similar everywhere. RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.29. Capacity of Supply Chain Components & Equipment to Scale

Rationale: Scale-up risk increases if supply chain components or underlying feedstock infrastructure necessary for these components cannot scale to handle Proponent feedstock requirements and throughput capacity. Capacity to scale should be demonstrated.	
Raw RI Score: PL is a by-product of poultry production. As such, PL availability within the Clarksville BDO Zone supply basin cannot increase without an increase in poultry production. Poultry production in Arkansas has continual increased for the past decade.[14] Based on this trend, it seems likely that poultry production (and therefore PL availability in the Clarksville BDO Zone) will continue to grow. Furthermore, within the Clarksville BDO Zone, an estimated 2.4 million tpy of PL (1.9 million from broilers and 0.5 million from turkeys) is generated. If a new bio-based facility were to require 150,000 tpy of PL (a facility using this amount of PL would be considered average by industry standards)[15], the coverage ratio or BAM would be 16 the facility's intake requirements. Risk associated with the capacity of the supply chain components and equipment to scale is deemed to be low. Raw RI Score is 1 out of 10.	**Score** 1
Notched Salience: No adjustment.	**Score Unnotched 1.0**
Impact Level: Due to the fact that the supply chain for 2.4 million tpy of PL already exists, the RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

[14] USDA Arkansas Field Office: www.nass.usda.gov/Statistics_by_State/Arkansas/Publications/Livestock_Releases/Production_and_Value/arbroilerPV.pdf

[15] Delaware Business Times: https://delawarebusinesstimes.com/news/new-partnership/.

APPENDIX B: INFRASTRUCTURE

Site selection of Clarksville, Arkansas

LOCATION

Clarksville is located on Interstate 40, close to the center-point of Memphis, St. Louis, Kansas City, Oklahoma City, and Dallas. The city lies on the south-central Johnson County, Arkansas at 35°27'50"N 93°28'38"W nestled between the Arkansas River and the foothills of the Ozark Mountains. According to the United States Census Bureau, Clarksville has a total area of 19.2 square miles, of which 18.5 square miles is covered by land and 0.69 square miles is covered by water.

POPULATION

As of the 2021 United States census, there were 9476 people, 3456 households and 2116 families residing in the City of Clarksville with a density of 514.99/sq mi. The population growth since 2010 is found to be 9%.

EMPLOYMENT

In 2020, Clarksville had a median household income of $ 35,811, with 57% of residents working in the Civilian Labor Force and 32% as Manufacturing Laborers. The largest industries in Clarksville are Manufacturing (1,221 people), Accommodation & Food Services (583 people) and Retail Trade (560 people). Some of the highest paying industries in the city are Finance & Insurance ($75,433) and Real Estate ($71,667). Compared to other places, Clarksville has an unusually high number of residents working in Production (3.42 times higher), Material Moving (3.06 times), Law Enforcement (4.07 times), Manufacturing (2.89 times) and Utilities (1.96 times). Clarksville's economy is heavily dependent on manufacturing, which represents nearly 40% of all jobs within the city. The next three largest sectors include health care (14%), retail (13%), and transportation & warehousing (13%).

SITE SELECTION

Clarksville has 5 Industrial sites- (1) 36-acre site bounded by N State Highway 109, S Crawford St, County Road 2331, and County Road 2340; (2) 60-acre site adjacent to Sterlin Hurley Ind Hwy; (3) 120-acre site adjacent to Massengale Rd; (4) 40-acre site adjacent to S Craxford St; and (5) 108-acre site adjacent to S Crawford St and N State Highway 109.

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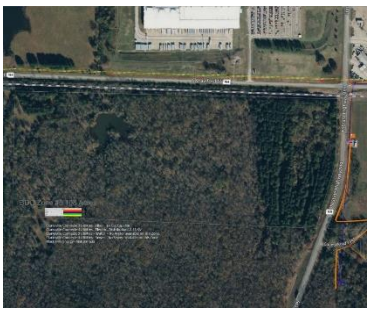


Details of 120-acre Clarksville Business Park

- Interstate 40 Clarksville Business Park is a city-owned 120-acre Industrial property located at 204 Massengale Road, Clarksville 72830, Johnson County, Arkansas.
- The site is bound by Interstate 40 to the north, Massengale Road to the north and east, undeveloped property to the south, and undeveloped property combined with a small residential development to the west.
- With an average daily traffic count over 25,000 and utilities on site, it is the ideal location for new development.
- Nite Light has a distribution facility adjacent to the property on the northeast corner and Wal-Mart has a 900,000 sq ft grocery distribution facility 1 mile to the south of this location.
- The site is owned by the City of Clarksville. The property is an Enterprise Zone as well as Industrial Park located within the city limits.
- Boring samples reveal ideal ground for large foundational construction.
- The Listing Sale Price is USD 10,000/Acre with maximum divisible area of 50 acres and minimum divisible area of 2.5 acres.

On-site Infrastructure:

- Clarksville Connected Utilities provides a Water line of 16" to the 36-acre property; and 12" Main line to other properties; excluding the 108-acre property. Although no water line is currently available there, it can be supplied by Clarksville Connected Utilities
- The 120-acre business park has water supply in excess capacity with recent $10 Million Expansion, Ozone Gas Disinfection, and a historic peak of 12.5 mgd that can be increased up to 24 mgd.
- All five Industrial sites have an Electric- Distribution of 12.45 KV provided by Clarksville Connected Utilities.
- Black Hill provides Natural Gas to all five Industrial sites. The 120-acre business park has a 3" Gas line on-site, 20,000 cubic feet per hour capacity, which can be upgraded to booster station for an increased capacity up to 400 MCFH.
- All five Industrial sites have a Fiber optic network with 1+ gigabyte bandwidth capacity provided by Clarksville Connected Utilities.
- Clarksville Connected Utilities provides Sewer line of 8" on the West and 10" on the East side of the 120-acre property; and a 6" main on the 60-acre property. However, other sites do not have sewers at the moment but can be served by the city.
- No known environmental conditions affecting development costs were found.
- Located in a US Treasury Approved Opportunity Zone, a tax incentive program providing an opportunity for private investors to support businesses and distressed communities are available.
- Eligible for New Market Tax Credits.
- There is a Municipal Fire Station Located on the 120-acre site with an ISO rating of 3.

Transportation Infrastructure

Interstates:

- ✓ 0.6 miles to Highway-64
- ✓ 0.7 miles to Primary Interstate I-40
- ✓ 39 miles to I-540
- ✓ 50.8 miles to I-49

Highways:

- ✓ 0.3 miles to Primary highway US-64
- ✓ 0.3 miles to HWY 103
- ✓ 0.3 miles to US Hwy 64
- ✓ 0.6 miles to State Hwy 109

Rail:

- ✓ 2 miles to Union Pacific Railroad
- ✓ 23.4 miles to Dardanelle and Russellville Railroad

Navigable Water:

- ✓ 3.1 miles to Primary Navigable Water Arkansas River
- ✓ 51.7 miles to Poteau River

Ports:

- ✓ 23.4 miles to Port of Dardanelle
- ✓ 47.9 miles to Port of Fort Smith
- ✓ 79.8 miles to Port of Little Rock

Air:

- ✓ 4.8 miles to Primary Airport Clarksville Muni (H35)
- ✓ 14.1 miles to Paris Muni (7M6)
- ✓ 51.7 miles to Fort Smith Regional
- ✓ 87.2 miles to Little Rock National

APPENDIX C: MAPS, CHARTS, AND FIGURES C

Map 1. Clarksville, AR BDO Zone

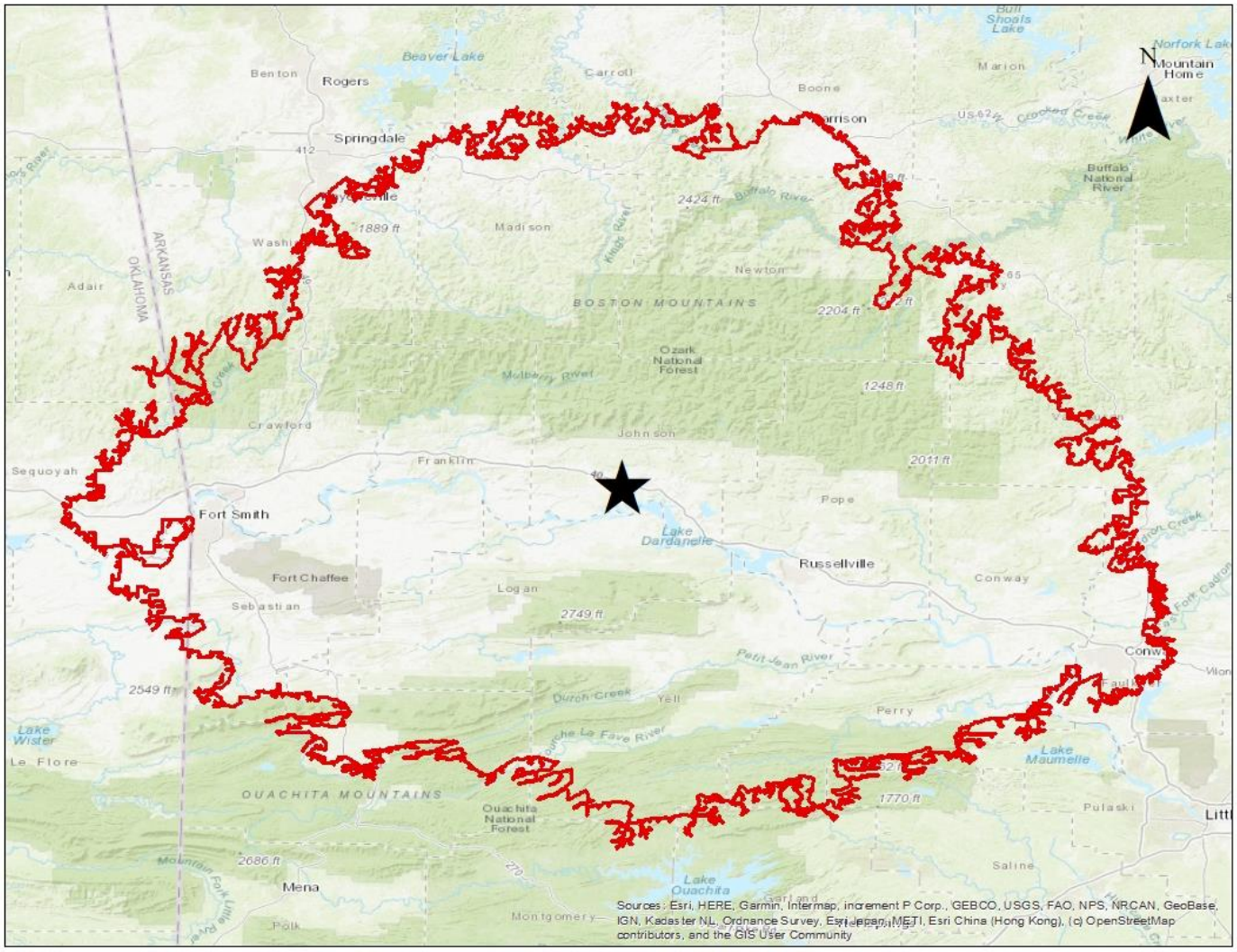
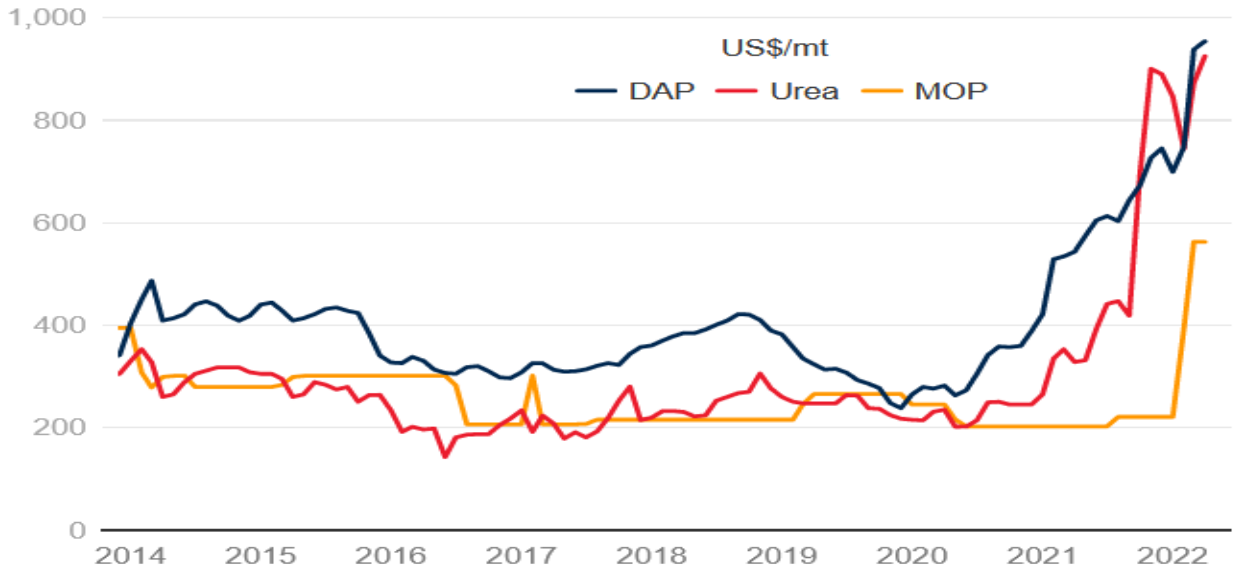


Figure 1. World Historical Fertilizer Prices, 2014-2022



Source: Bloomberg; World Bank: https://blogs.worldbank.org/opendata/fertilizer-prices-expected-remain-higher-longer

Note: DAP = diammonium phosphate. MOP = muriate of potash. Last observation is April 2022.

Figure 2. Gulf Coast No 2 Diesel Retail Prices



Source: U.S. Energy Information Administration Data: www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=EMD_EPD2D_PTE_R30_DPG&f=M

APPENDIX D: LEGAL DISCLAIMER

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