Bioeconomy Development Zone Risk Rating

A

Arlington, OR Bioeconomy Development Zone is rated "A". Long- term outlook on tipping fee and quantity of MSW is deemed stable. Key risks are likely addressable.

Rating Parameters

Quantity	Feedstock Type	Tipping Fee	BD Zone Drive Distance
350,000 tons/year	Municipal Solid Waste	$30/ton	75-140 miles

BD Zone Assets

- **Abundance of MSW available in the BD Zone: 2.7 million tons of MSW are generated each year. The quantity of MSW generated will continue to climb. Addtionally, 2.74 mllion tons of MSW are disposed of at the Columbia Ridge landfill in Arlington.**
- **Tipping fees have been historically increasing and will continue to increase.**
- **There are 18 different haulers and 8 transfer stations operating in the BD Zone.**
- **Postively rated infrastructure asset profile.**

BD Zone Liabilities

- **Any potential project would likely have to work with major waste hauler(s) to acquire MSW. The major waste haulers also own the largest landfills in the BD Zone, and therefore may (but not necessarily are) conflicted in terms of supplying MSW to the project.**

BD Zone Risk Rating

The Arlington Bioeconomy Development Zone is rated "A", or *low risk*.

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

In assessing the biomass supply chain risk for Arlington, OR Bioeconomy Development (BD) Zone, 36 Risk Indicators from the *US National Biomass Supply Chain Risk Standards* were applied. These BD Zone Risk Indicators are the subset of BSCR Risk Indicators applicable to gauging feedstock risk within a BD Zone.

Feedstock Quantity is expressed in short tons. Feedstock tipping fee is expressed in US dollars, FOB plant yard, assuming the plant is located centrally in the BD Zone. Maximum transport distance is based on current flows of MSW to the Columbia Landfill in Arlington.

Scoring and Ratings Methodology

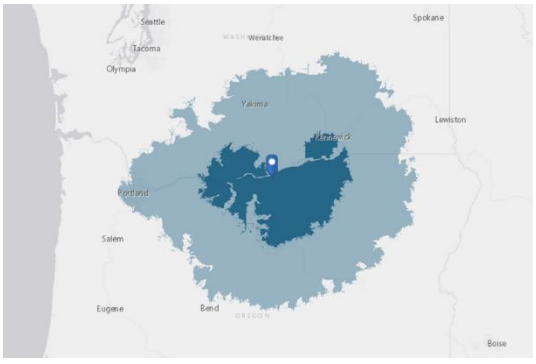
The BD Zone rating is based on an aggregation of the scores assigned to each BD Zone Risk Indicator (RI) assessed in this report. First, each BD Zone Risk Indicator is given a **Raw RI** score based on the research and analysis conducted on the MSW supply chain in the region. Raw RI Scores are scaled between 1 (*low risk*) and 10 (*high risk*).

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)*.

The **Loaded RI** score for each Risk Indicator is then calculated as the product of Raw RI and Impact Level scores. For example, Risk Indicator '*Supplier as competitor*' is scored at 4 and Impact Level is deemed high (i.e. 9.99). The final Loaded RI score for this risk indicator is therefore 4 x 9.99 = 39.96 (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*.

Arlington, OR BD Zone



The total risk rating for the BD Zone is the average of all Loaded RI scores. The BD Zone score for Arlington, OR is ***12.30 out of 100, resulting in an "A" designation.*** All scoring and rationale for each Risk Indicator is provided in Appendix B.

Analyst Notes

The Arlington BD Zone presents several strong assets. These include an abundance of MSW generated: there are an estimated 2.7 million tons of MSW generated within the BD Zone, including Oregon Metro. MSW generation has historically increased in the region, and this trend will continue. The increase is mainly correlated with increasing population and increasing incomes.

In 2017, for which most recent data were available, 2.74 million tons were disposed of at the Columbia Ridge Landfill in Arlington, a significant amount of it arriving from Portland, OR, and Seattle, WA.

Risks associated with supply chain development are low since an existing MSW supply chain is in existence: MSW is collected from residential, commercial and institutional sources; sorted at transfer stations and disposed of at landfills. Because a large portion of MSW generated in the BD Zone is disposed of at the Columbia Ridge Landfill, routes to Arlington are already established.

Risks related to decreasing tipping fees are also low. Tipping fees have been historically increasing, both nationally as well as locally (the current average tipping fee is $33.02/ton; Columbia Ridge Landfill charges between $30.22 and $41.89/ton, depending on where MSW originates). The expected increase in MSW generation will ensure that, with higher demand for disposal, tipping fees will continue to climb.

Risks related to the number, size, historical performance, and potential breach of suppliers are also low. There are 18 different haulers operating in the BD Zone. Additionally, there are 8 transfer stations. Although data on historical performance of these haulers and transfer stations (to understand their reliability) were unavailable, any potential supply disruptions due to a failure of a supplier are unlikely. This is because MSW is always generated and has to be disposed of; therefore, if a hauler or a transfer station cannot deliver, another supplier will.

Key High-*Risk* Indicators

Most significant risks in the Arlington MSW supply chain are classified into two categories: 1) risks related to large vertically integrated waste management companies; 2) risks related to securing MSW through Oregon Metro.

Risks related to large vertically integrated waste management companies

The second largest landfill in the BD Zone, Columbia Ridge Landfill, which is located in Arlington, is owned and operated by Waste Management. Waste Management also has contracts with Oregon Metro to haul part of the waste generated in the region. Moreover, Waste Management has a joint venture with InEnTec, a company developing an MSW-to-ethanol project at the Columbia Ridge Landfill. These factors may make it difficult for any new project to partner with Waste Management.

Similarly, Republic Services owns the Roosevelt Regional Landfill. Republic Services, a nation-wide vertically integrated waste management company, has been recently attempting to develop its own waste-to-product (for example, anaerobic digesters) facilities. Therefore, any new project may find it difficult to partner with Republic Services as well.

Nonetheless, the risks associated with Waste Management and Republic Services can be mitigated by: 1) contracting for MSW directly with Oregon Metro; 2) partnering with Waste Connections or other smaller haulers. Also note that Waste Management and/or Republic Services *may* be interested in supplying a potential project. The risks mentioned above are just that: risks.

Risks related to securing MSW through Oregon Metro

As mentioned above, to mitigate the risks associated with large vertically integrated waste management companies, a new project siting in Arlington can secure MSW directly from Oregon Metro. Verbal indications suggest that 60% of Oregon Metro's MSW currently goes to the Columbia Ridge Landfill in Arlington, composing the vast majority of MSW landfilled at the site. Oregon Metro has an ability to direct the MSW to any market it deems better suited.

However, Oregon Metro indicated that an MSW-utilizing facility would have to go through a stringent designation process in order to have access to MSW. Some of the factors Oregon Metro looks at include the conversion technology, viability of the business plan, and labor-related issues (such as wages and job security).

Since any project utilizing at least 350,000 tons per year of MSW would have to source feedstock from Oregon Metro, the designation process becomes a point of risk. *Note however, that this factor can be in favor of a potential project, as once it goes through the designation process it could secure MSW from Oregon Metro directly, side-stepping waste haulers and transfer stations.*

Infrastructure Asset Profile

The Arlington's infrastructure assets were scored on a scale of 0 - 10, with scores defined as follows: 0 (*insufficient*), 2 (*poor*), 4 (*fair*), 6 (*reasonable*), 8 (*good*), 10 (*very good*). 79% of all assets scored as either *good* or *very good*, and 0 scored as *poor* or *insufficient*. Among the top rated assets are the highway access, landfill access, sewage disposal trunk line, and land cost. Overall, Arlington presents a profile of positively rated infrastructure assets, with an average score of **8.07**. This score supplements Arlington's BD Zone rating, and reinforces it's **A** (*low risk*) designation. The full infrastructure asset profile is detailed in *Table 2*. Documentation supporting infrastructure assessment is available upon request.

Analyst Contact:

Marcin Lewandowski - *Director, Analytics & Risk*
marcin@ecostrat.com

Figure 1 - Risk Indicators (sorted by risk level)

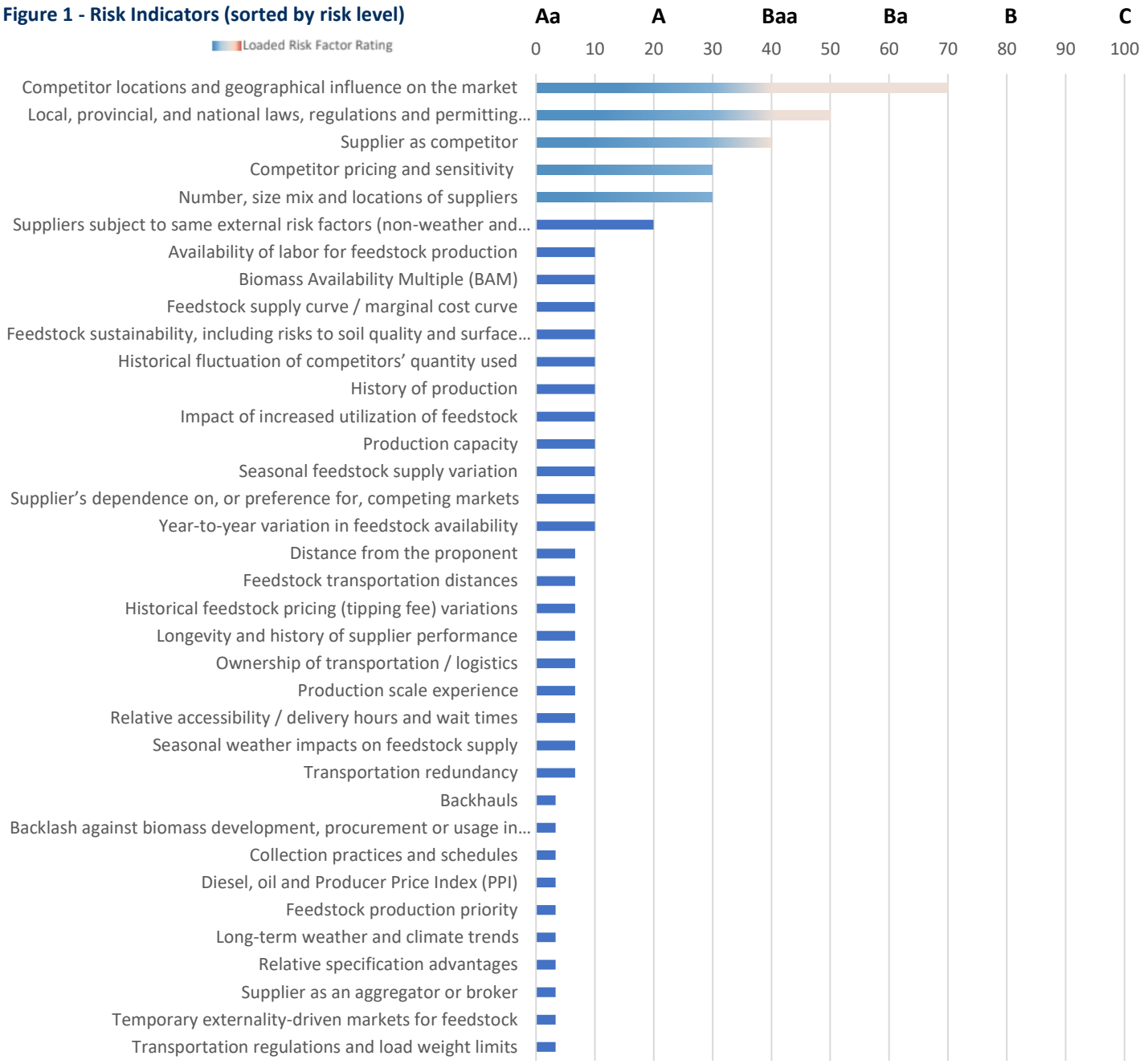


Table 1 - Risk Indicators

Feedstock Supply Chain Risk Indicators	Raw RI Score	Impact Level	Loaded RI Score
Category 1: Supplier Risk			
Longevity and history of supplier performance	1	6.66	6.66
Production capacity	1	9.99	9.99
Supplier's dependence on, or preference for, competing markets	1	9.99	9.99
Supplier as competitor	4	9.99	39.96
Ownership of transportation / logistics	2	3.33	6.66
Supplier as an aggregator or broker	1	3.33	3.33
Distance from the proponent	1	6.66	6.66
Production scale experience	1	6.66	6.66
Feedstock production priority	1	3.33	3.33
Category 2: Competitor Risk			
Competitor locations and geographical influence on the market	7	9.99	69.93
Historical fluctuation of competitors' quantity used	1	9.99	9.99
Competitor pricing and sensitivity	3	9.99	29.97
Relative accessibility / delivery hours and wait times	1	6.66	6.66
Relative specification advantages	1	3.33	3.33
Category 3: Supply Chain Risk			
Biomass Availability Multiple (BAM)	1	9.99	9.99
Impact of increased utilization of feedstock	1	9.99	9.99
Feedstock supply curve / marginal cost curve	1	9.99	9.99
Seasonal feedstock supply variation	1	9.99	9.99
Year-to-year variation in feedstock availability	1	9.99	9.99
Historical feedstock pricing (tipping fee) variations	1	6.66	6.66
History of production	1	9.99	9.99
Diesel, oil and Producer Price Index (PPI)	1	3.33	3.33
Collection practices and schedules	1	3.33	3.33
Temporary externality-driven markets for feedstock	1	3.33	3.33
Availability of labor for feedstock production	3	3.33	9.99
Feedstock transportation distances	1	6.66	6.66
Transportation regulations and load weight limits	1	3.33	3.33
Backhauls	1	3.33	3.33
Transportation redundancy	2	3.33	6.66
Number, size mix and locations of suppliers	3	9.99	29.97
Suppliers subject to same external risk factors (non-weather and equipment based)	3	6.66	19.98
Seasonal weather impacts on feedstock supply	1	6.66	6.66
Long-term weather and climate trends	1	3.33	3.33
Local, provincial, and national laws, regulations and permitting pertaining to biomass	5	9.99	49.95
Backlash against biomass development, procurement or usage in the region	1	3.33	3.33
Feedstock sustainability, including risks to soil quality and surface and groundwaters	1	9.99	9.99
		Risk Score	**12.30**

Table 2 - Asset Indicators

Infrastructure Assets	Overview	Score
Category 1: Physical Infrastructure		
1.1 Land Parcel	Port owned Airport Development sites, up to 8 acres remaining, Industrial Port owned sites, 30 acres remaining, and Industrial City owned sites, 126 acres remaining.	9
1.2 City Ownership	Industrial acres are owned by the Port and the City.	9
1.3 Industrial Land Use Zone	The land is zoned M1 (light industrial) and M2 (Service Industrial district (p164-165)). This land is suitable to accommodate a variety of projects including heavy industry.	8
1.4 Natural Gas Line	Natural gas line is available.	8
1.5 Electrical	A power study was completed for 250 MW via 230 kV line from Salt Substation. An additional 115kV BPA line can readily supply 15-20 MW of power, too. The substation is fed from top tier power generation facilities that can provide over 3,000 MW total.	8
1.6 Fresh Water Supply Line	Arlington MESA industrial part water system has a capacity of 670 gallons/minute. Plans are in place to bring additional wells online as needed.	8
1.7 Sewage Disposal Trunk Line	The maximum daily flow of the municipal sewer system is at 145,000 gallons/day while the current average is at 40,000 gallons.	9
1.8 Drainage	No data.	
1.9 Stormwater Management	Stormwater from site development will be accommodated by standard bioswales. The area witnesses low annual precipitation levels.	8
1.10 Natural Gas Power Generation Site	The nearest natural gas generation site is Carty Generating Station located 31 miles away.	8
1.11 Available ICT Services	Good. Fiber optics cabling is available and additional conduit has been placed throughout the industrial park.	8
1.12 Available Land	Good, an Environmental Site Assessment was conducted and concluded there were no recognized environmental conditions, and the site will not affect any federally endangered species.	8
1.13 Cost of Land - Initial Cost	Offered by the port at very competitive rates, with Gilliam county eligible incentives.	9
1.14 Cost of Land - Property Tax, Utilities	Incentives are likely available for renewable energy manufacturing facilities and an incentive for no Oregon sales tax (this has to be further verified with appropriate agencies).	6
1.15 Infrastructure - Pre-existing Plant Infrastructure	No data.	
1.16 Infrastructure - Landfill/waste disposal	Columbia Ridge landfill is located 11 miles from Arlington and is expected to operate for the coming 100 years.	10
2.1 Railway Spur Line	The industrial park is located within 10 miles of 2 Class I Railroad Intermodal (Shutler station and Arlington Spur).	8
2.2 Highway Access and Intersection	Interstate 84 access points are within 3.5 miles from the property that allow access to Tri-cities, Portland, Seattle, and Boise.	10
2.3 Proximity to Major Markets	Good rail and road transportation. The industrial park is within a day's drive from the California markets.	8
2.4 Inbound/Outbound Shipping Costs	No data.	8
2.5 Accessibility to Airport	Reasonable. The MESA industrial park is located south of the Arlington Municipal airport.	8
2.6 Railway Service	There is an 11 mile rail service from Arlington, OR to Gilliam, OR. Railway connects to the national network.	8
2.7 Logistics - Construction Logistics	Good. Considering a possible work camp during construction period.	8
3.1 Quality of Life	Family-friendly. Good outdoor activities (water and land) with a few restaurants and a couple hotels.	8
3.2 Education - Elementary & High School	Fair. Arlington, OR is services by the Arlington School District #3 which has an elementary and a high school on adjoining campuses.	6
3.3 Education - Post Secondary	Fair. There are no universities or colleges in Arlington, OR. However, there are community colleges nearby. Columbia Gorge community college (55 miles), Blue Mountain College (72 miles), and Yakima Valley College (101 miles) are some of the colleges around. Oregon State University is located 220 miles away from Arlington, OR.	6
3.4 Local Retail	No data.	
3.5 Culture and Recreation	Excellent sports facilities, Columbia river is on the north side of the city. There also is a golf club and paddle boards available.	8
3.6 Hospital and Doctors	Arlington has the Arlington Medical Centre located in the city.	7
3.7 Housing Availability	110 affordable and available rental homes per 100 renters in Gilliam county, the county also has an attainable housing incentive program. Moreover, the Arlington Community Chamber of Commerce has the Homestead Rebate program that aims to pay people to live in Gilliam county.	7
3.8 Crime Rate	Very low crime in Gilliam county.	10
	Total	***8.07***



Bioeconomy Development Zone Program Advisory Group

Jordan Solomon, Ecostrat

Jeffrey Steiner, Oregon State University

Doug Falkner, Leatherstocking

Chris Tindal, CAAFI

Chris Cassidy, USDA

Ryan DeGroft, Business Oregon

John Audley, JJA

David Van't Hof – Climate Solutions

Kristin Brandt – Washington State University

APPENDIX A: RISK SCORES

Category 1: Supplier Risk

Longevity and history of supplier performance

Raw RI Score. Historical data and the number of years in business of each transfer station were unavailable. In case of transfer stations, other attributes can be used to understand reliability. Firstly, ownership type (public or private) can indicate the likelihood of facility shut down or curtailment. Public transfer stations have lower risk of shut down or curtailment because they do not rely solely on financial profit/loss balance but can be subsidized by the taxpayer in times of trouble. Private transfers stations, on the other hand, have to remain profitable. Again, 3 transfer stations in the BD Zone are public and 8 are private. Secondly, the impact of a transfer station shut down or curtailment on feedstock supply is low. MSW is generated and has to be disposed of regardless of the existence of a particular transfer station; in case of a transfer station shut down or curtailment, either other transfer stations would expand, or a new transfer station would need to be constructed. In other words, any transfer station shut down and curtailments would not have a effect on the net availability of MSW. Therefore, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 6.66**

Production capacity

Raw RI Score. There is an estimated 2,686,554 tpy of MSW generated in the BD Zone. This represents 7.68x the 350,000 tpy this rating is issued for. Additionally, there is an estimated 2,740,000 tpy of MSW disposed at the Columbia Ridge landfill. This represents 7.83x the 350,000 tpy this rating is issued for. The redundancies of 7.68x and 7.83x are considered low risk. Therefore, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 9.99**

Supplier's dependence on, or preference for, competing markets

Raw RI Score. Other than Waste Management and Republic Services (see 'Supplier Competitor' RI below), none of the other waste haulers or transfer stations is likely to have a preference for a landfill, assuming that tipping fees at a potential MSW recycling / processing project are lower than those of the landfill. Therefore, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 9.99**

Supplier as competitor

Raw RI Score. Two waste hauling companies can pose a risk due to vertical integration: Waste Management and Republic Services. Waste Management collects and transports MSW in a few Oregon Metro areas. It also owns the Columbia Ridge Landfill. Republic Services, which also operates in Oregon Metro, owns the Roosevelt Landfill, the largest landfill in the BD Zone. In addition to the fact that Waste Management and Republic Services own landfills, anecdotal information[1] suggests that they also attempted to bid on the development of anaerobic digesters. This suggests that both waste haulers plan to expand their businesses by entering / expanding the waste recycling / processing business. Moreover, Waste Management, in partnership with InEnTec, already developed an MSW processing facility at the Columbia Ridge Landfill (the status of the InEnTec facility is unknown). Additionally, neither Waste Management nor Republic Services were open to conversations about development of MSW processing sites close to their landfills. This supports the thesis that Waste Management and Republic Services plan on eventually entering the MSW processing sector or that they are already working with other development companies. Note that the fact that Waste Management and Republic Services were not interested in having conversations about a potential MSW-processing project within the study timeframe does not necessarily mean that they would not be eventually interested in supplying such project once development takes place. Therefore, the lack of Waste Management's and Republic Services' response and their activities associated with developing their own projects should be considered a risk, not the haulers' definite exclusion from the supply chain. In addition to Waste Management and Republic Services, there are 16 more waste haulers and 5 transfer stations owned by companies that are likely to be interested. More importantly, Oregon Metro is increasing the tonnage of MSW it controls and wants to divert. For example, Oregon Metro indicated that a couple of years ago 100% of the MSW generated within its boundaries was disposed of at the Columbia Ridge Landfill. Currently, it is 60%, as Oregon Metro works on creating markets for MSW and finding partners that could recycle / process MSW. Oregon Metro indicated that eventually it would like most of	**Score 4**

[1] Source: Oregon Metro.

its waste (estimated 2.5 million tons/year) to be hauled to an MSW recycling / processing facility.

The assigned raw RI score is 4 out of 10 for the following reasons:

- Waste Management and Republic Services own the two largest landfills in the BD Zone. They also likely control large quantities of MSW. These companies did not respond to our requests for a conversation about a potential MSW-processing project within the study timeframe.
- The vast majority of MSW potentially available in the BD Zone would come from Oregon Metro. Oregon Metro plans to maximize the diversion of its MSW to facilities that recycle / process MSW into products.
- 350,000 tons/year, a quantity for which this BD Zone rating is issued, is a fraction of MSW generated in the region. It is also a fraction of what the Columbia Ridge landfill accepts annually. Therefore, even if Waste Management and Republic Services would not supply MSW, this quantity is likely to be available from other sources.

Impact Level. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 39.96**

Ownership of transportation / logistics

Raw RI Score. MSW is transported by waste haulers. In certain cases, waste haulers are vertically integrated; that is, they own transfer stations and landfills. In other cases, haulers provide solely MSW collection and hauling services. 6 out of 8 transfer stations in the BD Zone are privately owned by 3 companies: Waste Connections (owns 3 transfer stations), Republic Services (owns 2 transfer stations) and The Dalles Disposal Service (owns 1 transfer station). These privately owned transfer stations own MSW hauling equipment (trucks) as well. The two publicly owned transfer stations, City of Condon and Morris County – Public Works, likely do not own transportation equipment. Because the majority of transfer stations own MSW hauling equipment, but not all, the raw RI score is 2 out of 10.	**Score 2**
Impact Level. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 6.66**

Supplier as an aggregator or broker

Raw RI Score. By the nature of how MSW is generated, all suppliers can be considered aggregators. That is, waste haulers and transfer stations collect, or aggregate, residential and commercial waste for further processing or disposal. However, this does not pose any risk to the supply chain. Therefore, the assigned score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 3.33**

Distance from the proponent

Raw RI Score. This risk indicator refers to the distance from transfer stations to Arlington. Although the distance does play a role in determining where MSW is disposed of, currently the majority of MSW generated in the BD Zone is disposed of at the Columbia Ridge Landfill. Therefore, it is safe to assume that the majority of MSW processed at the transfer stations within the BD Zone ends up in Arlington. Consequently, it is safe to assume that the vast majority of MSW sorted at transfer stations within the 75-mile BD Zone supply basin would be accessible to a potential project. Therefore, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 6.66**

Production scale experience

Raw RI Score. Production scale experience refers to i) the quantity of collected MSW by waste haulers; and ii) the quantity of sorted MSW by transfer stations. There are 18 waste haulers collecting MSW in the BD Zone with varying production scale experience. However, the production scale experience with respect to waste haulers is of limited importance: if a waste hauler cannot handle MSW collection, other waste haulers would step in and collect the material, resulting in a stable collection of MSW. In other words, because MSW must be collected, the production scale experience of any given waste hauler is irrelevant from the perspective of total feedstock availability. In terms of the production scale experience of transfer stations, there are no data that indicate MSW throughput by each transfer station. However, 5 out of the 8 transfer stations are owned either by Republic Services or Waste Connections, both of which have a great deal of experience in waste management. Therefore, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 6.66**

Feedstock production priority

Raw RI Score. The first line of business for waste haulers and transfer stations is to collect and sort MSW. In other words, suppliers must prioritize MSW production. Therefore, the raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 3.33**

Category 2: Competitor Risk

Competitor locations and geographical influence on the market

Raw RI Score. Landfills' locations are shown on Map 2. The most significant landfill is Columbia Ridge Landfill, located in Arlington. In addition to the landfill, there is a MSW processing facility co-jointly owned by InEnTec and Waste Management. These two facilities have a significant influence on the market for MSW in Arlington. Note that this impact is limited by the fact that this BD Zone is issued for 350,000 tons/year. Since Columbia Ridge Landfill accepts 2,740,000 tpy, a potential project consuming 350,000 tons per year would represent 13% of the Columbia Ridge Landfill's intake. Therefore, considering the close proximity of Columbia Ridge Landfill and InEnTec to Arlington, and accounting for the fraction of waste that would be required for a potential project, the raw RI score assigned is 7 out of 10.	**Score 7**
Impact Level. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 69.93**

Historical fluctuation of competitors' quantity used

Raw RI Score. No historical data for total MSW disposed at landfills were available. However, 3-year historical data indicating MSW generated in the state of Washington and disposed of each landfill were available. We use that data as proxy to determine historical trends in MSW disposal at landfills. Based on quantities of Washington-generated MSW disposed at landfills located within the BD Zone, there is a significant increase in disposed MSW in the BD Zone. In 2016, the quantity disposed increased by 185,579 tons compared to 2015. In 2017, the region experienced an MSW disposal increase of 221,918 tons, compared to 2016. The same increasing trend was experienced by the Columbia Ridge Landfill in Arlington.	**Score 1**

However, this trend of increasing MSW disposal does not pose risk to a potential project. In fact, it benefits a potential project by indicating that higher quantities of MSW could be potentially available year-to-year.
Therefore, the raw RI score for this risk indicator is 1 out of 10.

Impact Level. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 9.99**

Competitor pricing and sensitivity

Raw RI Score. The average landfill tipping fee in the BD Zone is $33.01/ton. The landfill price sensitivity is unknown. It is likely however, that landfills could easily tolerate the $30/ton tipping fee this BD Zone assessment is issued for. That said, landfills are considered a last resort, but necessary, disposal option (for example, Oregon Metro is currently working on diverting as much waste as possible). Therefore, they are not solely competing on tipping fees, which decreases the risk associated with this risk indicator. The tipping fee offered by InEnTec is unknown. Therefore, the assigned raw RI score is 3 out of 10.	**Score 3**
Impact Level. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 29.97**

Relative accessibility / delivery hours and wait times

Raw RI Score. Landfills are relatively accessible with long operating hours. However, it is likely that any project would be equally accessible. Therefore, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 6.66**

Relative specification advantages

Raw RI Score. Landfills will always have an advantage in terms of feedstock quality. Landfills accept all streams of MSW; MSW composition does not matter for landfills. However, it is assumed here that any potential project would have similar feedstock quality tolerance as landfills. Therefore, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 3.33**

Category 3: Supply Chain Risk

Biomass Availability Multiple (BAM)

Raw RI Score. There is an estimated 2,686,554 tons per year of MSW generated within the BD Zone. This represents 7.68x the 350,000 tpy this BD Zone designation is issued for. Additionally, 2,740,000 tpy of MSW are disposed of at the Columbia Ridge landfill in Arlington, representing 7.83x the 350,000 tpy this BD Zone is issued for. Due to such high feedstock redundancy, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 9.99**

Impact of increased utilization of feedstock

Raw RI Score. Due to the high generation of MSW and an increasing generation trend, the impact of increased utilization of feedstock would be minimal. Therefore, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 9.99**

Feedstock supply curve / marginal cost curve

Raw RI Score. The MSW generation curve in Figure 1 shows the quantity of MSW generated as a function of distance from Arlington. The vast majority of MSW considered in this assessment is generated at a distance of ~140 miles from Arlington, in Oregon Metro[2]. The main conclusion derived from the generation curve is that any project locating in Arlington and requiring 350,000 tons/year of MSW would have to source the feedstock from Oregon Metro. This point is irrelevant however, since currently 60% of Oregon Metro's MSW goes to the Columbia Ridge Landfill in Arlington. Additionally, approximately 2,740,000 tpy of MSW is disposed of at the Columbia Ridge Landfill in Arlington. This includes 60% of MSW generated by Oregon Metro and approximately 819,000 tpy generated by the state of Washington , including Seattle. Therefore, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 9.99**

Seasonal feedstock supply variation

Raw RI Score. While no seasonal data are available for the entire BD Zone, seasonal weekly MSW collection data are available for Portland, the largest urban center in the state (Figure 2). Despite rather significant variation in MSW generation week-to-week, no seasonal trends can be identified. Therefore, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 9.99**

Year-to-year variation in feedstock availability

Raw RI Score. Data were available for years 2015 to 2017. Each year the quantity of MSW generated in the BD Zone increased significantly. This trend is likely to continue due increasing population and incomes. Therefore, there is no year-to-year variation in MSW generation; rather, an expected continual increase. For this reason, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 9.99**

[2] The distances used to generate the curve are based on county seats. That is, the quantity of MSW generated by a particular county is assumed to be generated by the county seat (as its most populous area). This means that all MSW generated by Oregon Metro is assumed to be generated by the City of Portland, located 140 miles from Arlington.

Historical feedstock pricing (tipping fee) variations

Raw RI Score. The landfill pricing (tipping fee) trend has been constant and upward: tipping fees tend to increase continually, as indicated by Figure 4. Therefore, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 6.66**

History of production

Raw RI Score. Data were available for years 2015 to 2017. Each year the quantity of MSW generated in the BD Zone increased significantly. This trend is likely to continue due to increasing population and incomes. Therefore, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 9.99**

Diesel, oil and Producer Price Index (PPI)

Raw RI Score. Changes in diesel prices are not expected to increase landfill tipping fees significantly. Any additional costs due to increased diesel prices are usually passed on to the generator. Therefore, the assigned raw RI risk score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 3.33**

Collection practices and schedules

Raw RI Score. MSW is collected from commercial and residential areas on a regular basis. This ensures a consistent and regular flow of MSW. Consequently, collection practices and schedules are not a risk for an MSW-utilizing facility. Therefore, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 3.33**

Temporary externality-driven markets for feedstock

Raw RI Score. No temporary externality-driven markets for MSW exist. Therefore, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 3.33**

Availability of labor for feedstock production

Raw RI Score. Data on employment in the waste management sector are collected annually by the United States Bureau of Labor Statistics. According to its most recent publication, dated May 2019, there were 101,990 people employed in the industry in Oregon and 167,950 in Washington. Workers in the industry earned an average annual salary of $49,914 in Oregon and $58,131 in Washington. Employment data collected by the United States Bureau of Labor Statistics demonstrates that there is currently a large availability of laborers with the necessary skills and expertise to support feedstock procurement, transportation and other assorted feedstock-management tasks. It is expected that the availability of laborers will remain constant in the future. This is due to a variety of factors. Firstly, waste management jobs are non-seasonal meaning that they provide year-round employment which simultaneously maintains the stability and reliability of the entire workforce and attracts additional laborers to the industry. Additionally, many waste management jobs in Oregon and Washington are unionized. They are also relatively well paid. Indeed, laborers employed in the waste management industry in Washington made about five thousand more dollars annually than the national average of $53,490, while in Oregon, salaries were comparable to the national average. Furthermore, unionized jobs provide various benefits and ensure job-security, further attracting laborers to the industry. These aspects of employment in the waste management industry make it likely that there will be a consistent supply of available laborers to carry on feedstock procurement and management activities. Despite the facts mentioned above, availability of labor is a real concern for waste haulers. Although labor shortages were not identified in Oregon or Washington, waste haulers in Georgia do experience them. Therefore, to account for this risk, the assigned raw RI score is 3 out of 10.	**Score 3**
Impact Level. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 9.99**

Feedstock transportation distances and costs

Raw RI Score. Waste collection routes in the region are well established and take place according to a set schedule. As a result, the average transportation cost per-unit of delivered material is well known and unlikely to drastically fluctuate. That being said, if transportation costs were to increase in the region, it would not pose any major risk to the project. This is because, any increases in transportation costs are passed down to the customer. Because MSW must be disposed of in a solid waste facility, generators of MSW are forced to pay any additional costs incurred as a result of increases in transportation costs, thus mitigating risk. One minor variable that increases supply chain risk due to transportation cost is the fact that transportation costs are always an important variable in biomass supply chains. Although we feel that transportation costs pose negligible risk, the assigned raw RI score is 2 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 6.66**

Transportation regulations and load weight limits

Raw RI Score. In Oregon, the maximum legal gross weight of trucks is 80,000 pounds. In Washington, this limit is 105,500 pounds. For comparison, a loaded garbage dump truck weight up to 60,000 pounds. This risk indicator is negligible because the MSW supply chain is already in existence. Specifically, tipping fees consider costs associated with weight limits. Therefore, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 3.33**

Backhauls

Raw RI Score. No opportunities for backhauls between Oregon Metro (where the majority of MSW is located) and Arlington were identified. Nonetheless, current tipping fee at the Columbia Ridge Landfill assumes there are no backhaul opportunities. Since we rate the supply-chain based on current tipping fees, the lack of backhaul opportunities do not pose any risk. Therefore, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 3.33**

Transportation redundancy

Raw RI Score. Transportation redundancy is built into the MSW supply chain. The supply chain has to provide reliable off-take of MSW as per contracts with municipalities and MSW generators. If reliable off-take is not provided, a waste hauler would lose business. For this reason, over time, the waste management industry has developed an efficient and robust supply chain unlikely to experience severe disruptions. However, the actual transportation redundancy is not known. To account for this, we lower the score by 1 point. Therefore, the assigned raw RI score is 2 out of 10.	**Score 2**
Impact Level. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 6.66**

Number, size mix and locations of suppliers

Raw RI Score. There are 18 waste hauling companies and 8 transfer stations. The waste hauling companies range from large corporations, such as Waste Management and Republic Services, to smaller local companies, such as Oregon City Garbage Co. On the other hand, transfer stations tend to be owned either by large corporations (Waste Connections, Republic Services) or publicly owned by counties or cities. The risk score is decreased by the relatively large number of waste hauling companies in the region. On the other hand, it is increased by the relatively small number of transfer stations owned by just a few of large companies (for example, Waste Connections and Republic Services). Therefore, the assigned score is 3 out of 10.	**Score 3**
Impact Level. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 29.97**

Suppliers subject to same external risk factors (non-weather and equipment based)

Raw RI Score. Waste haulers are a subject to several external risk factors. Perhaps the highest-impact risk relates to labor strikes. Since waste hauling jobs tend to be unionized, strikes are likely. For example, Republic Services experienced nation-wide strikes in 2019 (though it is unknown whether Oregon employees where part of that strike)[3]. That said, due to the essential nature of waste hauling services, historically strikes by waste management employees have ended quickly, whether by an agreement between employees and the waste hauling company, or by government legislation. No other external (non-weather and equipment based) risk factors were identified. Therefore, to account for the risks related to labor strikes, the assigned risk score is 3 out of 10.	**Score 3**
Impact Level. RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 19.98**

Seasonal weather impacts on feedstock supply

Raw RI Score. Weather may affect MSW collection and disposal in the very short-term. For example, in a storm MSW collection and disposal may be delayed. However, these delays are very short-term, and do not pose risk to the general availability of MSW. In fact, extreme weather events have the potential to increase MSW generation. For example, an extreme rainfall event may create flooding likely to damage interiors, thus increasing MSW generation in the short-term. Therefore, while seasonal weather patterns do not significantly affect MSW generation, extreme weather events that occur randomly have the potential to positively increase feedstock supply in the short-term. Therefore, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 6.66**

Long-term weather and climate trends

Raw RI Score. Long-term weather and climate trends do not pose risks to the MSW supply chain. Therefore, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 3.33**

[3] Source: https://www.wastetodaymagazine.com/article/republic-services-workers-protest/

Local, provincial, and national laws, regulations and permitting pertaining to biomass

Raw RI Score. Any potential project locating in Arlington and requiring 350,000 tons/year of MSW would have to source MSW from Oregon Metro. In order to acquire feedstock from Oregon Metro, the project would have to be *designated*. To designate an MSW-procesing project, Oregon Metro looks at a number of items, including (but not limited to) the conversion technology and employee wages. Further investigation into the designation process would have to be conducted by a project-developer. In this report it is assumed that any MSW-processing project that locates in Arlington would meet Oregon Metro criteria to be *designated*. However, since Oregon Metro effectively controls MSW supply in the Arlington BD Zone, this risk indicator is deemed medium: the assigned raw RI score is 5 out of 10. It is worth noting that the fact the Oregon Metro controls MSW supply can be in favor to a potential project. This is because Oregon Metro may decide to supply the MSW to the project, at which point all waste haulers would be forced to do so, effectively removing the competitive advantage vertically integrated waste management companies have.	**Score 5**
Impact Level. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 49.95**

Backlash against biomass development, procurement or usage in the region

Raw RI Score. Some large energy projects proposed in Oregon faced public backlash. For example, there was an organized opposition to a wind turbine project in Union, OR. Residents can oppose an MSW-processing project in a similar way. However, this risk is mitigated by the fact that there is an existing landfill and an MSW infrastructure. Any new MSW-processing project, especially at a scale of ~300,000 tpy of feedstock intake, would not compromise the local environment significantly. In fact, the potential for local job creation and a positive image of an MSW-processing technology (i.e. preventing garbage landfilling) is expected to mitigate the risk of resident backlash further. Therefore, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 3.33**

Feedstock sustainability, including risks to soil quality and surface and groundwaters

Raw RI Score. MSW is currently considered an environmental and social liability. Any project converting MSW to a product would be considered sustainable. Therefore, the assigned raw RI score is 1 out of 10.	**Score 1**
Impact Level. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score. The Loaded RI Score is a product of Raw RI Score and Impact Level.	**Score 9.99**

APPENDIX B: ASSESSMENT OF THE MSW SUPPLY CHAIN

INTRODUCTION

This assessment provides research and analysis conducted for the purpose of designating Arlington with the BD Zone designation. Appendix 2 applies this research and analysis for risk scoring purposes.

This BD Zone designation is conducted with the following two variables:

- Quantity: 350,000 tons per year;
- Tipping fee: $30 per ton (based on the regional average tipping fee and the lower end tipping fee of the Columbia Ridge landfill).

Supply and Competition Basin

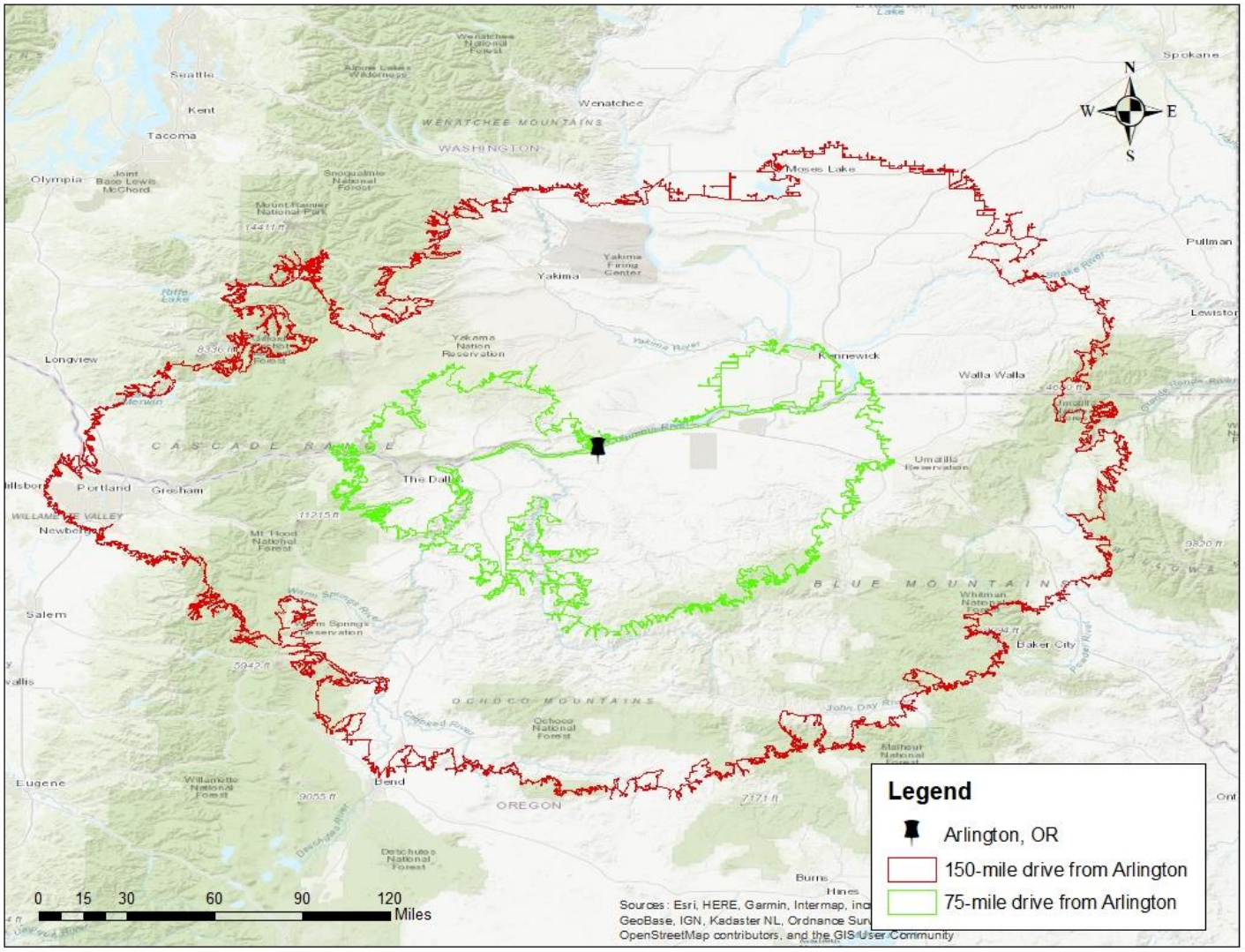
A supply basin is an area from which MSW can be economically sourced. For the purposes of the BD Zone designation, the supply basin is defined as an area within 75-mile drive distance from Arlington. For the purposes of estimating MSW generation in the supply basin, we also included Oregon Metro region. This is because currently most of MSW that is landfilled in Arlington at the Columbia Ridge Landfill comes from Oregon Metro. Additionally, it is worth noting that MSW arrives to the Columbia Ridge Landfill from as far as Seattle and to the Roosevelt Regional Landfill from as far as Alaska[4]. Therefore, the actual supply basin (i.e. the region from which MSW can be sourced) is actually larger than the 75-mile drive distance and Oregon Metro. Nonetheless, for the purposes of this report, and to remain conservative in our estimates, we define the supply basin as 75-mile drive distance from Arlington plus Oregon Metro.

Some of the supply analysis performed for this BD Zone designation could only be conducted at a county level. Counties which county seats are within 75-mile drive of Arlington were analyzed in this assessment. The following are these counties: Gilliam, OR, Sherman, OR, Morrow, OR, Umatilla, OR, Wheeler, OR, Wasco, OR, Klickitat, WA.

The competition basin is defined as an area double that of the supply basin: 150-mile drive distance from Arlington, depicted in lighter blue on Map 1.

[4] Source: https://www.nwnewsnetwork.org/economy-business-finance-and-labor/2017-09-21/competing-for-your-trash-the-huge-hidden-landfills-of-the-columbia-river-gorge

Map 1: Arlington BD Zone supply and competition basins



Supply Chain Overview

The MSW supply chain typically consists of five components: (i) curbside pickup typically contracted with waste haulers; (ii) transport to a transfer station; (iii) waste consolidation and sorting at a transfer station; (iv) transport from a transfer station to a landfill; (v) disposal at a landfill. Sometimes the transfer station step (ii and iii) is omitted, and waste is transported directly to a landfill. Typically, at each step, a fee, referred to as a *tipping fee* (per ton), is paid from one entity to another.

An MSW-processing project can acquire feedstock from two types of entities: waste haulers and transfer stations. Additionally, it can contract with a government agency, such as Oregon Metro, to acquire feedstock.

SUPPLY

High-level supply (MSW generation)

To understand the quantity of MSW that could be available to a project locating in Arlington, we used two methods:

1) We estimated MSW generated in the supply basin.
2) We assumed that MSW currently arriving at the Columbia Ridge Landfill could be made available to a potential project.

MSW generated in the Supply Basin

The following are estimates for MSW generated by each county. For counties in Oregon, the estimates are provided by the Oregon Department of Environmental Quality[5]. For counties in Washington, the estimates are based on an assumption that 6.94 lbs of MSW are generated per person on a daily basis[6].

In 2018, there were an estimated 204,089 tons of MSW generated within 75-mile drive of Arlington. The Oregon Metro region generated an estimated 2,482,465 tons of MSW. Therefore, there were an estimated 2,686,554 tons of MSW generated within the 7 counties located within 75 miles and the Oregon Metro region together (Table 1).

Table 1: MSW generation in 2018 by county

County Name	County Seat	Distance from County Seat to Arlington (mi)	Quantity of MSW Generated in 2018 (tons)
Gilliam, OR	Condon, OR	38	4,247
Klickitat, WA	Goldendale, OR	46	28,402
Morrow, OR	Heppner, OR	52	24,479
Sherman, OR	Moro, OR	52	1,426
Wasco, OR	The Dalles, OR	54	28,345
Wheeler, OR	Fossil, OR	57	514
Umatilla, OR	Pendleton, OR	72	116,676
Total within 75-mile drive			**204,089**
Oregon Metro	Portland, OR	140	2,482,465
Total with Oregon Metro			**2,686,554**

The MSW generation curve in Figure 1 shows the quantity of MSW generated as a function of distance from Arlington. The vast majority of MSW considered in this assessment is generated at a distance of ~140 miles from Arlington, in Oregon Metro[7]. The main conclusion derived from the generation curve is that any project locating in Arlington and requiring

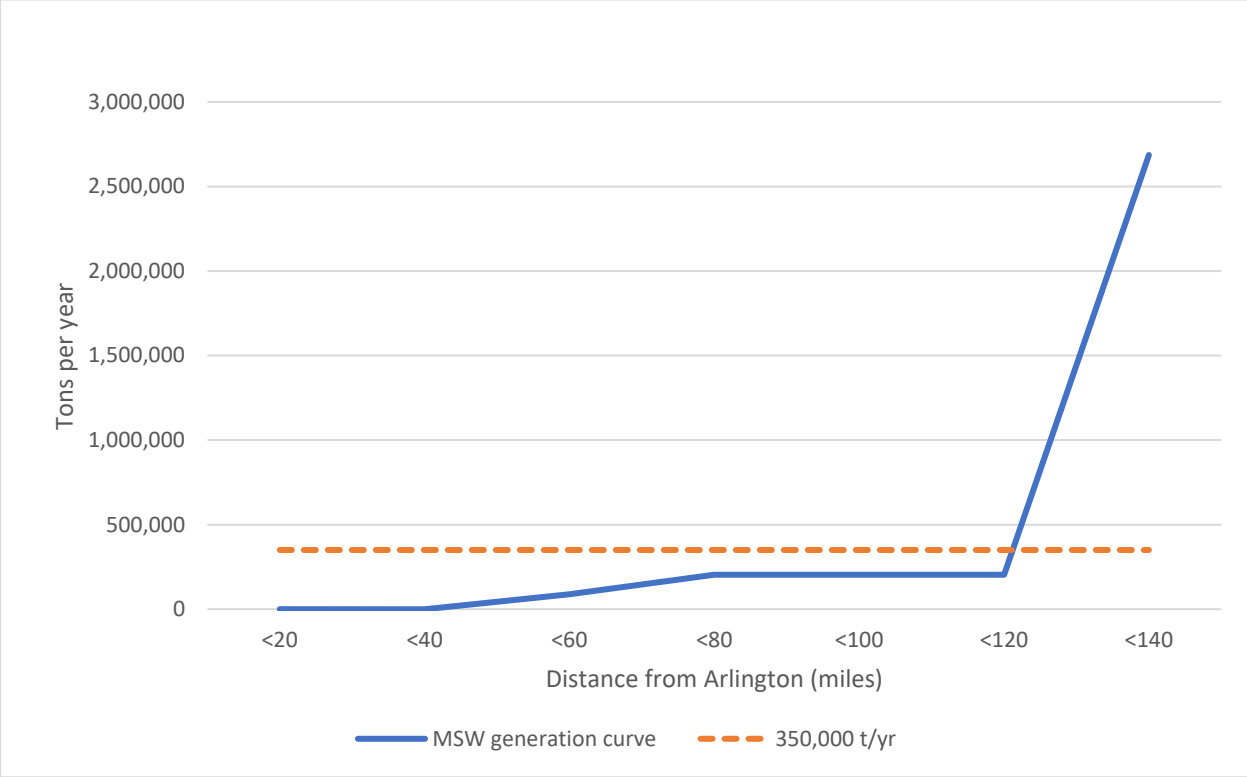
[5] Source: Oregon Department of Environmental Quality. 2018 Material Recovery and Waste Generation Rates Report. https://www.oregon.gov/deq/recycling/Documents/2018MRWGRatesReportTables.pdf

[6] Source: Washington Department of Ecology. https://ecology.wa.gov/Asset-Collections/Doc-Assets/Solid-waste/Solid-waste-recycling-data/Material-recovery-and-disposal-2016

[7] The distances used to generate the curve are based on county seats. That is, the quantity of MSW generated by a particular county is assumed to be generated by the county seat (as its most populous area). This means that all MSW generated by Oregon Metro is assumed to be generated by the City of Portland, located 140 miles from Arlington.

350,000 tons/year of MSW would have to source the feedstock from Oregon Metro (this point is moot however, since currently 60% of Oregon Metro's MSW goes to the Columbia Ridge Landfill in Arlington).

Figure 1: MSW generation curve



MSW currently arriving at the Columbia Landfill

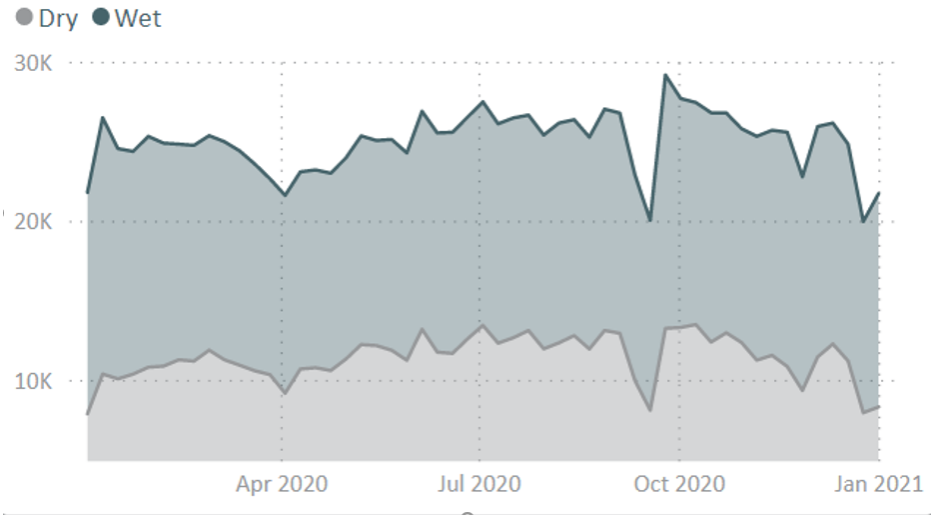
Approximately 2,740,000 tpy of MSW is disposed of at the Columbia Ridge Landfill in Arlington. This includes 60% of MSW generated by Oregon Metro[8] and approximately 819,000 tpy generated by the state of Washington[9], including Seattle.

Seasonal feedstock supply variation / year-to-year supply variation

While no seasonal data are available for the entire BD Zone, seasonal weekly MSW collection data are available for Portland, the largest urban center in the state (Figure 2). Despite rather significant variation in MSW generation week-to-week, no seasonal trends can be identified.

[8] Source: verbal information Oregon Metro.
[9] Data as of 2017. Source: https://ecology.wa.gov/Research-Data/Data-resources/Solid-waste-recycling-data

Figure 2: Quantity of weekly MSW collection in Portland, OR.



MSW generated is a function of the consumption behaviors of households and businesses in a given region. However, changes in these consumption patterns across all businesses and individuals within a given region are difficult to measure and even more difficult to forecast over time. As a result, proxy variables are often used in studies as predictor variables, predicting the amount of MSW generated within a certain region.

One of the most accurate MSW generation forecasting models is the Regional Core Discards Model put together by Metro Oregon. This is an econometric model which uses a variety of proxy variables to forecast the amount of MSW generated and discarded by households and businesses. According to the research conducted by the creators of the model, the proxy variables which are most significantly correlated to MSW generation are population and regional employment.

Population is directly correlated to MSW generation as more people in a municipality generate more waste. Population increases relatively slowly and consistently from year to year. In the last 20 years, the population of Oregon has increased at a rate of about 1.1% annually, while in Washington, the population has increased at an annual rate of about 1.34% in the same time frame.

Employment is directly related to a person's overall economic output which has been shown to be correlated with waste disposal levels. Therefore, increases in employment in a given region are expected to yield greater waste disposal in that same region. According to a November 2020 study conducted by Washington State's Employment Security Department, the expected average annual growth rate in employment for the years 2018-2023 is 1.51% and 1.18% for the years between 2023-2028. In Oregon, the state's Employment Department projects that job growth will total 9% between 2019 and 2029.

Suppliers

For the purposes of this assessment, MSW suppliers were categorized into two categories: 1) waste haulers; 2) transfer stations.

Waste Haulers

There are 18 waste hauling companies collecting and transporting MSW in the BD Zone (including Oregon Metro)[10]. Data on the volume hauled by each waste hauler were unavailable. These haulers are, in alphabetical order:

- Arrow Sanitary
- Bliss Sanitary
- Canby Disposal
- Columbia River Disposal
- Evergreen Disposal
- Garbarino Disposal
- Gresham Sanitary
- Hillsboro Garbage Disposal
- Hoodview Disposal and Recycling
- Molalla Sanitary
- Oregon City Garbage Co.
- Portland Disposal and Recycling
- Pride Disposal
- Republic Services
- Robanco Ltd.
- Walker Garbage Service
- Waste Management of Oregon
- West Linn Refuse and Recycling
- Dalles Disposal Service

Transfer stations

There are 8 transfer stations within 75-mile drive of Arlington. Of those, 6 transfer stations are private, and 2 are publicly owned (Table 2).

Historical performance. A supplier's historical performance is an indicator of its future reliability. However, historical data and the number of years in business of each transfer station were unavailable. That said, other attributes of the transfer stations can be used to understand a transfer station's reliability. Firstly, ownership type (public or private) can indicate the likelihood of facility shut down or curtailment. Public transfer stations have lower risk of shut down or curtailment because they do not rely solely on financial profit/loss balance but can be subsidized by the taxpayer in times of trouble. Private transfers stations, on the other hand, have to remain profitable. Again, 2 transfer stations in the BD Zone are public and 6 are private.

Secondly, the impact of a transfer station shut down or curtailment on feedstock supply is low. MSW is generated and has to be disposed of regardless of the existence of a particular transfer station; in case of a transfer station shut down or

[10] Note that we did not include companies currently transporting MSW to the Columba Ridge landfill by rail.

curtailment, either other transfer stations would expand or a new transfer station would need to be constructed. In other words, any transfer station shut down and curtailments would not have an effect on the net availability of MSW.

Table 2: Transfer stations within the BD Zone

Facility Name	Owner	Distance From Arlington (miles)	State	Ownership Type
North Morrow County Transfer Station	Waste Connections	31	OR	Private
Sherman County Transfer Station	Morrow County - Public Works	35	OR	Public
South Morrow Transfer Station	City of Condon	36	OR	Public
Condon Transfer Station	Waste Connections	37	OR	Private
The Dalles Transfer Station	The Dalles Disposal Service	49	OR	Private
Goldendale Transfer Station	Republic Services	49	WA	Private
Dallesport Transfer Station	Republic Services	54	WA	Private
Pendleton Transfer Station	Waste Connections	71	OR	Private

Transfer station profiles

The following are short profiles of each transfer station by owner. Note that no data on transfer station throughput were available.

Waste Connections

Waste Connections owns three transfer stations in the supply basin. Waste Connections is a vertically integrated solid waste services company that provides non-hazardous waste collection, transfer and disposal services, along with recycling and resource recovery. Waste Connections is present in 43 states in the US and six provinces in Canada.

The three transfer stations owned and operated by Waste Connections are:

- North Morrow County Transfer Station, located 31 miles from Arlington;
- Condon Transfer Station, located 37 miles from Arlington;
- Pendleton Transfer Station, located 71 miles from Arlington.

Morrow County Public Works

The Sherman County Transfer Station is a public transfer station owned by Morrow County Public Works. The transfer station is located 35 miles from Arlington.

City of Condon

The South Morrow Transfer Station is a public transfer station owned by the City of Condon. The transfer station is located 36 miles from Arlington.

The Dalles Disposal Service

The Dalles Transfer Station is a private transfer station owned by the Dalles Disposal Service. It is located in The Dalles, 49 miles from Arlington.

Republic Services

Republic Services is the second largest non-hazardous solid waste collection, transfer, disposal, recycling, and energy services in the United States, as measured by revenue. Republic Services owns two transfer stations in the supply basin:

- Goldendale Transfer Station, located 49 miles from Arlington;
- Dallesport Transfer Station, located 54 miles from Arlington.

Number, size, mix and locations of suppliers

There are 18 waste hauling companies and 8 transfer stations. The waste hauling companies range from large corporations, such as Waste Management and Republic Services, to smaller local companies, such as Oregon City Garbage Co. On the other hand, transfer stations tend to be owned either by large corporations (Waste Connections, Republic Services) or publicly owned by counties or cities.

Suppliers: other potential risk indicators

Supplier as an aggregator or broker

By the nature of how MSW is generated, all suppliers can be considered aggregators. That is, waste haulers and transfer stations collect, or aggregate, residential, commercial, and institutional waste for further processing or disposal.

Supplier as a competitor / supplier's dependence on competing markets

Two waste hauling companies can pose a risk due to vertical integration: Waste Management and Republic Services. Waste Management collects and transports MSW in a few Oregon Metro areas. It also owns the Columbia Ridge Landfill. Republic Services, which also operates in Oregon Metro, owns the Roosevelt Regional Landfill, the largest landfill in the BD Zone. In addition to the fact that Waste Management and Republic Services own landfills, anecdotal information[11] suggests that they also attempted to bid on the development of anaerobic digesters. This suggests that both waste haulers plan to expand their businesses by entering / expanding the waste recycling / processing business. Moreover, Waste Management, in partnership with InEnTec, already developed an MSW processing facility at the Columbia Ridge Landfill (the status of the InEnTec facility is unknown).

Additionally, neither Waste Management nor Republic Services were open to conversations about development of MSW processing sites close to their landfills. This supports the thesis that Waste Management and Republic Services plan on eventually entering the MSW processing sector or that they are already working with other development companies.

Note that the fact that Waste Management and Republic Services were not interested in having conversations about a potential MSW-processing project within the study timeframe does not necessarily mean that they would not be

[11] Source: Oregon Metro.

eventually interested in supplying such project once development takes place. Therefore, the lack of Waste Management's and Republic Services' response and their activities associated with developing their own projects should be considered a risk, not the haulers' definite exclusion from the supply chain.

In addition to Waste Management and Republic Services, there are 16 more waste haulers and 5 transfer stations owned by companies that are likely to be interested in supplying to a potential project. More importantly, Oregon Metro is increasing the tonnage of MSW it controls and wants to divert. For example, Oregon Metro indicated that a couple of years ago 100% of the MSW generated within its boundaries was disposed of at the Columbia Ridge Landfill. Currently, it is 60%, as Oregon Metro works on creating markets for MSW and finding partners that could recycle / process MSW. Oregon Metro indicated that eventually it would like most of its waste (estimated 2.5 million tons/year) to be hauled to an MSW recycling / processing facility.

Production scale experience

Production scale experience refers to i) the quantity of collected MSW by waste haulers; and ii) the quantity of sorted MSW by transfer stations. There are 18 waste haulers collecting MSW in the BD Zone with varying production scale experience. However, the production scale experience with respect to waste haulers is of limited importance: if a waste hauler cannot handle MSW collection, other waste haulers would step in and collect the material, resulting it a stable collection of MSW. In other words, because MSW must be collected, the production scale experience of any given waste hauler is moot from the perspective of total feedstock availability. In terms of the production scale experience of transfer stations, there are no data that indicate MSW throughput by each transfer station. However, 5 out of the 8 transfer stations are owned either by Republic Services or Waste Connections, both of which have a great deal of experience in waste management. For this reason, production scale experience is not a risky factor in the BD Zone's MSW supply chain.

Feedstock production priority

The first line of business for waste haulers and transfer stations is to collect and sort MSW. In other words, suppliers must prioritize MSW production.

DEMAND

Competitors

The main competitors for MSW are landfills. Two main factors influence the degree to which landfills compete for MSW: ownership type (private vs. public) and the type of vertical integration. Private landfills tend to be active in the market, attempting to maximize the amount of tipping fee collected. This is done either by increasing tipping fees and/or disposing of more MSW. Although both these tactics are often regulated and constrained by the government, tipping fee maximization remains the main strategy of private landfills.

Privately owned landfills can more effectively maximize tipping fees when they are vertically integrated, with waste hauling businesses, transfer stations, and even waste processing/recycling operations. The more steps in an MSW supply chain a company controls, the higher the opportunity for profit. This means that the waste companies tend to strive for vertical integration, and once vertical integration is achieved, the waste companies protect it.

Two examples specific to the Arlington supply basin are Waste Management and Republic Services. Both of these large companies are already vertically integrated, while trying to integrate even more by entering into the waste processing business, for example, anaerobic digestion.

In contrast, *public* landfills' main mandate, in general, is to provide a reliable waste disposal service to a local jurisdiction (in most cases, a county). Although important, tipping fees and profit are of lesser concern to public landfills than to private landfills. Additionally, public landfills tend to be smaller than private landfills. For these reasons, in general, public landfills do not actively compete for MSW on the market.

In general, therefore, supply chains with a larger proportion of publicly owned landfills are less risky from MSW-processing facility development perspective.

Landfills

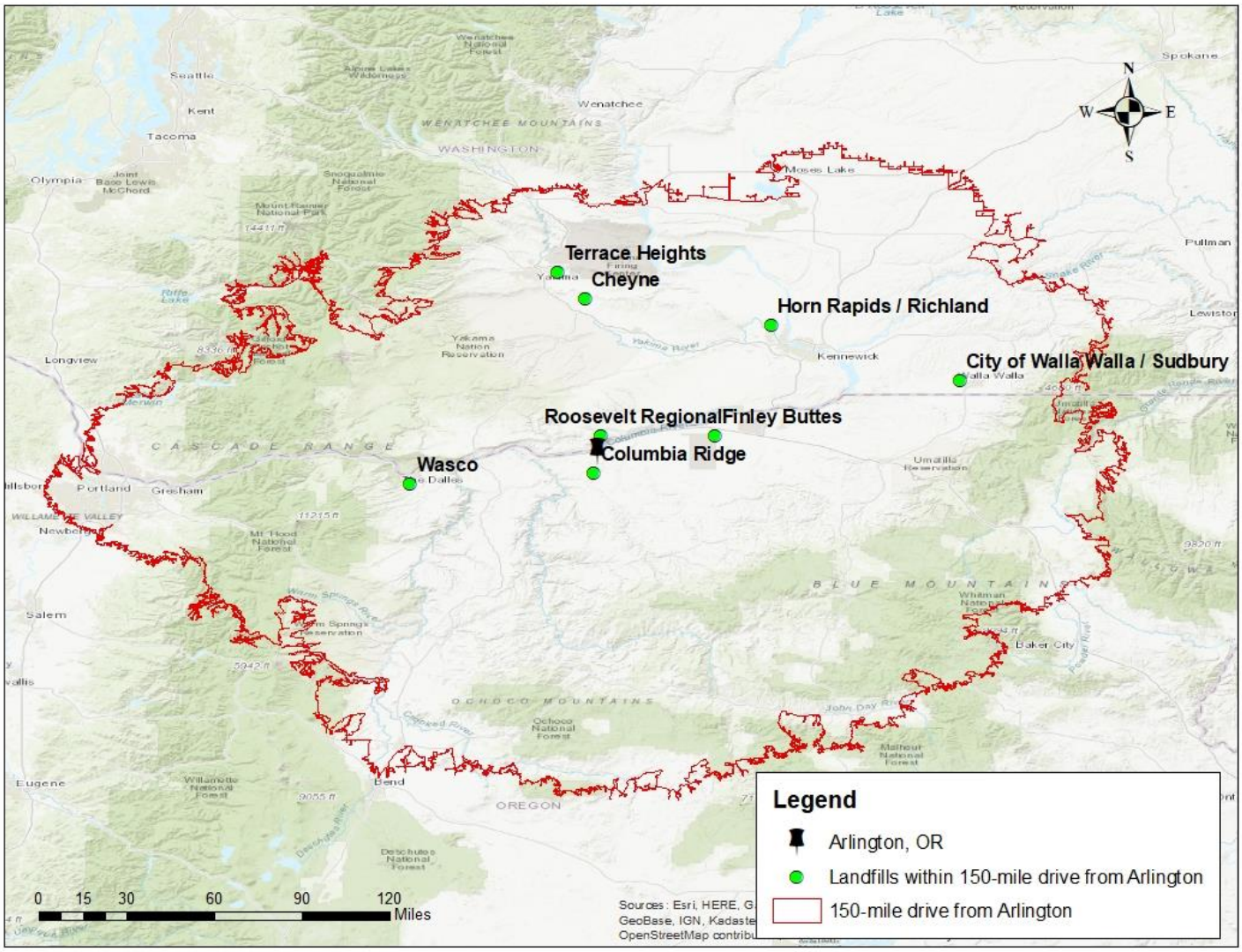
There are 8 landfills located within 150-mile drive of Arlington. 4 of these landfills are publicly owned, 4 are private. Interestingly, the 4 landfills in closest proximity to Arlington are all private. Table 3 lists these landfills (in the order of proximity to Arlington), quantity of MSW received in 2017 (last year of available data), and the tipping fees they charge.

Table 3: Landfills within 150 miles of Arlington

Landfill Name	Owner Type	Owner	City	Distance to Arlington (mi)	MSW Intake (tpy)	MSW Intake Data Year	Low Tipping Fee ($/ton)	High Tipping Fee ($/ton)*
Columbia Ridge	Private	Waste Management	Arlington, OR	11	2,740,000	2017	30.22	41.89
Finley Buttes	Private	Waste Connections	Boardman, OR	41	500,000	2015	16.85	34.85
Wasco	Private	Wasco County Landfill Inc. (subsidiary of Waste Connections)	The Dalles, OR	58	680,000	2018	42.30	-
Roosevelt Regional	Private	Republic Services	Bickleton, WA	73	2,500,000	2017	29.00	
Horn Rapids / Richland	Public	City of Richland	Richland, WA	95	53,000	2010	76.15	76.15
City of Walla Walla / Sudbury	Public	City of Walla Walla	Walla Walla, WA	102	51,000	2021	-	-
Cheyne	Public	Yakima County	Zilah, WA	104	73,000	2014	-	-
Terrace Heights	Public	Yakima County	Yakima, WA	118	166,000	2014	36.00	-

*High tipping fee is based on rates for waste generated outside the county the landfill is located in.

Map 2: Locations of landfills within 150-miles of Arlington



Future competitors

The only identified future competitor is an InEnTec facility at the Columbia Ridge Landfill.

InEnTec / S4 Energy Solutions

S4 Energy Solutions is a joint venture between InEnTec and Waste Management, which owns and operates the Columbia Ridge Landfill. S4 Energy Solutions is a proposed gasification plant that plans to produce syngas and ethanol from. It is unclear what stage of development the plant is at currently; however, the project already went through the pilot stage and its full license was approved in 2019 by Oregon Department of Environmental Quality. The expected MSW intake of the plant is also unknown.

Competitors: Other items to discuss

Historical fluctuation of quantity used

No historical data for total MSW disposed at landfills were available. However, 3-year historical data indicating MSW generated in the state of Washington and disposed of each landfill were available. We use that data as proxy to determine historical trends in MSW disposal at landfills.

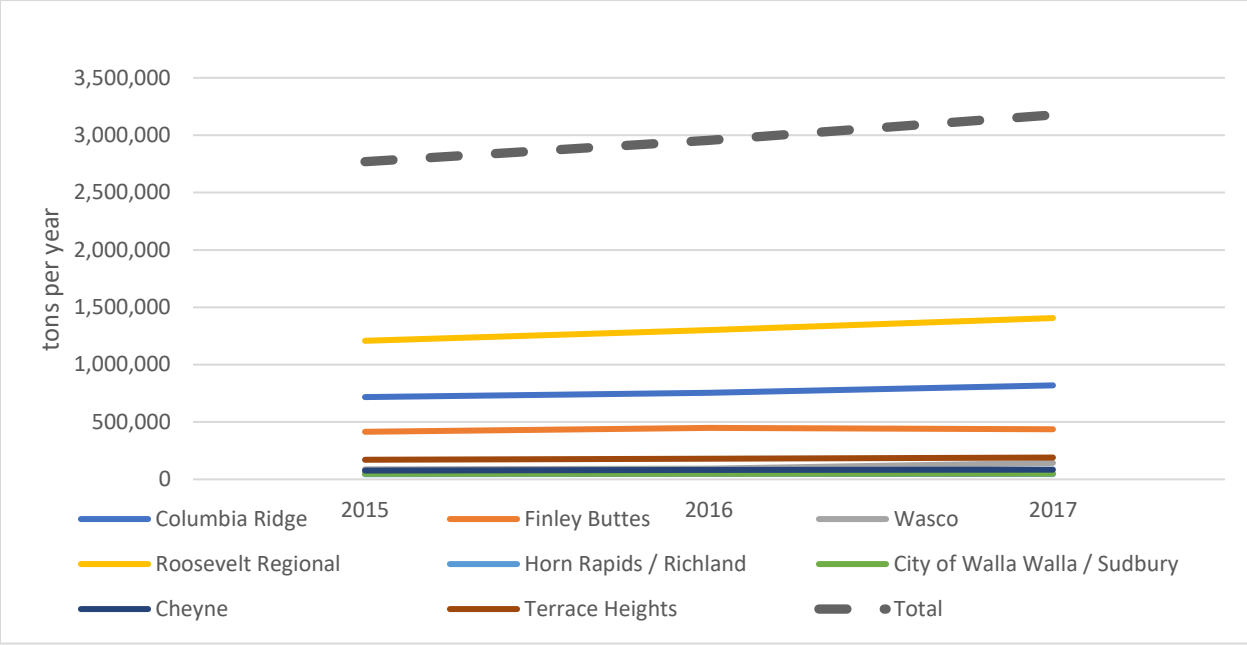
Based on quantities of Washington-generated MSW disposed at landfills located within the BD Zone, there is a significant increase in disposed MSW in the BD Zone. In 2016, the quantity disposed increased by 185,579 tons compared to 2015. In 2017, the region experienced an MSW disposal increase of 221,918 tons, compared to 2016. The same increasing trend was experienced by the Columbia Ridge Landfill in Arlington.

However, this trend of increasing MSW disposal does not pose risk to a potential project. In fact, it benefits a potential project by indicating that higher quantities of MSW could be potentially available year-to-year.

Table 4: Disposed MSW generated in Washington by landfill, 2015 – 2017

Landfill Name	Quantity of Washington-generated MSW disposed (tons/year)		
	2015	2016	2017
Columbia Ridge	717,093	754,246	819,157
Finley Buttes	414,771	448,727	436,477
Wasco	87,226	92,742	143,350
Roosevelt Regional	1,208,033	1,301,146	1,406,253
Horn Rapids / Richland	44,680	47,337	46,758
City of Walla Walla / Sudbury	50,024	49,285	50,067
Cheyne	76,639	81,609	84,636
Terrace Heights	170,905	179,858	190,170
Total	2,769,371	2,954,949	3,176,867

Figure 3: Disposed MSW generated in Washington by landfill, 2015 – 2017



PRICING

Current pricing

6 out of the 8 identified landfills within the BD Zone provided tipping fees. The average tipping fee is $33.02/ton[12]. Columbia Ridge Landfill, located in Arlington, charges a tipping fee of $30.22/ton for MSW generated within the county, and $41.89/ton for MSW generated outside of the county.

Historical tipping fees

In January 2021 the Environmental Research & Education Foundation (EREF)[13] published an analysis of MSW landfill tipping fees across the entire United States. According to this study, tipping fees at MSW landfills have shown an increasing trend across the entire nation since 2016. In the Pacific Region of the United States, the average year-over-year increase in tipping fees between 2016 and 2020 was 4.4% annually.

The EREF identifies 2 main drivers of tipping fee price variations; competition and ownership type. When it comes to competition, it states "regions with larger landfills potentially need fewer landfills to manage any waste generated and are insulated from pricing competition". That is to say, tipping fees in areas with few large landfills tend to experience linear increases in price as there is little competition driving prices downwards. With regards to ownership type, the EREF states that "the ownership status (i.e. private vs. public) of larger landfills could also influence the tipping fee such that privately-owned landfills have a greater ability to increase prices and are not necessarily bound by local policies".

[12] This average does not include an outlier: the Horn Rapids / Richland public landfill, which charges a tipping fee of $76.15/ton. The likely reason for such high tipping fee is that the landfill accepts mainly waste generated by the City of Richland; any waste coming from outside of the city is a subject to increased landfill tipping fees.

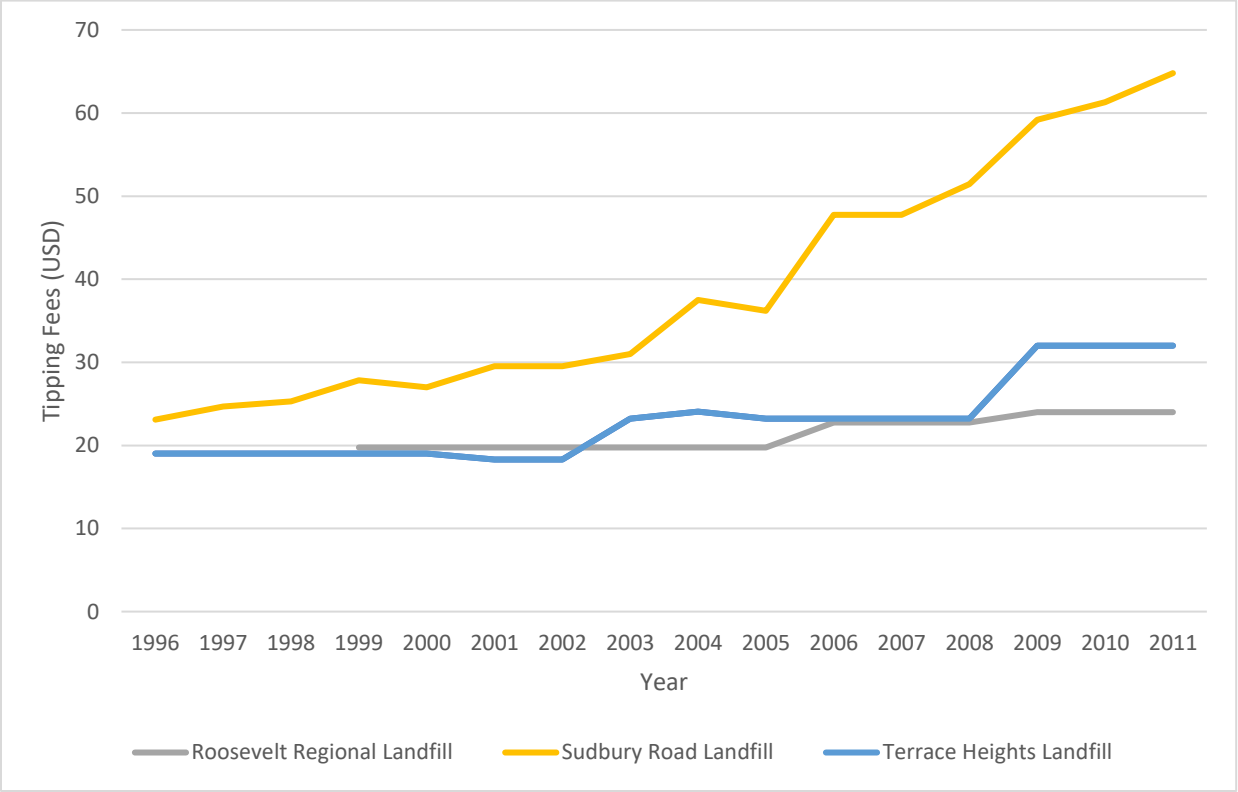
[13] The Environmental Research & Education Foundation (EREF) is an independent scientific research institution which specializes in researching waste management practices across the United States.

When assessing the status of the two indicators the EREF has identified as drivers of trends in tipping fees (competition and ownership type), it can be expected that tipping fees in the region will continue to increase steadily without any major fluctuations between years. This is because, competition is minimal in the region. In fact, three major companies dominate the market. These companies are Waste Connections, Republic Services and Waste Management. Most of the waste generated in this region is landfilled at a facility owned by one of these three players.

Additionally, all the aforementioned companies (Waste Management, Republic Services, Waste Connections) are privately owned. This further reinforces the expectation that prices will increase stadily thoughout time in the region, given the relative freedom private companies have to set prices.

Tipping fees are observed to increase steadily through time. From 1996 to 2011, all landfills for which data were available (Roosevelt Regional, Sudbury, Terrace Heights) have shown a steady increase through time (Figure 4).

Figure 4: Historical landfill tipping fees in the US



TRANSPORTATION

Transportation redundancy

Transportation redundancy is built into the MSW supply chain. The supply chain has to provide reliable off-take of MSW as per contracts with municipalities and MSW generators. If reliable off-take is not provided, a waste hauler would lose business. For this reason, over time, the waste management industry has developed an efficient and robust supply chain unlikely to experience severe disruptions.

Transportation regulations and load weight limits

In Oregon, the maximum legal gross weight of trucks is 80,000 pounds. In Washington, this limit is 105,500 pounds. For comparison, a loaded garbage dump truck weights up to 60,000 pounds.

Ownership of transportation

MSW is transported by waste haulers. In certain cases, waste haulers are vertically integrated; that is, they own transfer stations and landfills. In other cases, haulers provide solely MSW collection and hauling services. 6 out of 8 transfer stations within 75-mile drive of Arlington are privately owned by 3 companies: Waste Connections (owns 3 transfer stations), Republic Services (owns 2 transfer stations) and The Dalles Disposal Service (owns 1 transfer station). These privately owned transfer stations own MSW hauling equipment (trucks) as well. The two publicly owned transfer stations, City of Condon and Morris County – Public Works, do not own transportation equipment.

INFRASTRUCTURE

Availability of labor

Data on employment in the waste management sector are collected annually by the United States Bureau of Labor Statistics. According to its most recent publication, dated May 2019, there were 101,990 people employed in the industry in Oregon and 167,950 in Washington. Workers in the industry earned an average annual salary of $49,914 in Oregon and $58,131 in Washington.

Employment data collected by the United States Bureau of Labor Statistics demonstrates that there is currently a large availability of laborers with the necessary skills and expertise to support feedstock procurement, transportation and other assorted feedstock-management tasks. It is expected that the availability of laborers will remain constant in the future. This is due to a variety of factors. Firstly, waste management jobs are non-seasonal meaning that they provide year-round employment which simultaneously maintains the stability and reliability of the entire workforce and attracts additional laborers to the industry. Additionally, many waste management jobs in Oregon and Washington are unionized. They are also relatively well paid. Indeed, laborers employed in the waste management industry in Washington made about five thousand more dollars annually than the national average of $53,490, while in Oregon, salaries were comparable to the national average. Furthermore, unionized jobs provide various benefits and ensure job-security, further attracting laborers to the industry. These aspects of employment in the waste management industry make it likely that there will be a consistent supply of available laborers to carry on feedstock procurement and management activities.

POLICY

Local, federal, and national laws, regulations and permitting pertaining to biomass

Any potential project locating in Arlington and requiring 350,000 tons/year of MSW would have to source MSW from Oregon Metro. In order to acquire feedstock from Oregon Metro, the project would have to be *designated*. To designate an MSW-processing project, Oregon Metro looks at a number of items, including (but not limited to) the conversion technology and employee wages[14]. Further investigation into the designation process would have to be conducted by a project-developer.

It is worth noting that the fact that Oregon Metro controls MSW supply can be in favor to a potential project. This is because Oregon Metro may decide to supply the MSW to the project, at which point all waste haulers would be forced to do so, effectively removing the competitive advantage vertically integrated waste management companies have.

[14] Source: Oregon Metro.