TETRA TECH

KING COUNTY, WASHINGTON
EVALUATION OF LONG-TERM DISPOSAL OPTIONS

TABLE 1A
COMPARATIVE EVALUATION SUMMARY
LOW TONNAGE (HIGH DIVERSION) SCENARIO
(367,202 TONS/YEAR)

	Waste Export by Rail (WEBR)	Mass Burn	Gasification	Pyrolysis	Refuse Derived Fuel (RDF)
Disposal Option Description	A Waste Export by Rail (WEBR) option would export compacted municipal solid waste (MSW) in intermodal containers via railroad transportation to an out-of-county landfill after the permitted disposal capacity at Cedar Hills Regional Landfill is reached. WEBR is a proven disposal option used by neighboring jurisdictions, including the City of Seattle, Kitsap County, Thurston County, Skagit County, and Snohomish County. There are two Intermodal Facilities (IMFs) that can service King County including the BNSF South Seattle Intermodal Facility located at 12400 51st Pl S. in Tukwila, WA and UPRR Seattle Intermodal Terminal (aka ARGO Yard) located at 4700 Denver Ave. So. in Seattle, WA. There are 3 primary regional landfills in the Northwest receiving waste by rail. These include: Columbia Ridge and Finley Buttes Landfills in Oregon, and Roosevelt Regional Landfill in Washington. All 3 can receive King County's waste by rail with a combined capacity sufficient to handle the county's waste in the long term under any of the 3 tonnage scenarios posed by the County. Each of the three WEBR landfills also have ash monofills. Utilization of existing (MF infrastructure is assumed, for this Study.	Mass Burn is a type of Waste-to-Energy technology that heats and burns MSW, producing steam which is used to generate electricity. Mass Burn is a well-established municipal solid waste (MSW) disposal option more commonly found in Europe and Asia with over 70 plants in the US. In this type of facility. Waste is generally burned as received with minimal pre-processing (some screening may be required for bulky items or large inerts). Mass Burn also has a wide allowance of waste energy value as the primary limitation is at the upper end of the energy threshold. The ash residual from the burning process is disposed of at a separate ash monofill facility. Mass Burn facilities typically create energy in the form of high-pressure steam that can be used directly for industrial processes, district heating, and/or to generate electricity. There are restrictions on Mass Burn electricity sales in State of Washington due to the Clean Energy Transformation Act (CETA) for utilities selling to retail customers (by 2045) as waste-to-energy is not considered renewable energy for retail sales by CETA. Electricity can be sold to wholesale and interstate customers. The Climate Commitment Act (CCA) would impose cap-and-trade offset purchases, adding to Mass Burn costs. In order to handle the expected waste from the low tonnage scenario, the Mass Burn facility footprint would likely need to be between 10 and 20 acres in size depending on local conditions (such as land availability and costs	Gasification is a process that transforms MSW (using high heat, high pressure and limited oxygen) into usable products, typically synthetic gas (syngas) that can be used as a fuel, processed into industrial chemicals such as ammonia and methanol, and converted to renewable natural gas. The solid residuals can be used as a sub-base for construction of roadbeds. Unlike Mass Burn, the temperature of the heat is several hundred degrees lower and front-end processing is typically required to create a suitable feedstock that can be thermally transformed. A Gasification facility that processes MSW is uncommon. Most Gasification facilities are demonstration or pilot plants under 20,000 tons per year and process a homogeneous feedstock such as biomass (organics/wood waste), plastics, coal or tires. Using Gasification technologies to process municipal solid waste is considered developing and not commercially proven. The variability of the materials being heated affects the compounds in the syngas. The largest facility in North America was in Edmonton, Canada (110,000 tons/year) with limited operations over the past 10 years and is scheduled for retirement. The syngas quality is unpredictable from heterogeneous materials such as municipal solid waste. Methanol was selected for the Economic Analysis, under the potential for commodity sales, because the Gasification reference facility that was used in Edmonton, Alberta, Canada was designed to transform syngas into methanol, even though the revenue from producing methanol was considered to be academic and not commercially proven. In order to manage the expected waste from the low tonnage scenario, the Gasification facility footprint would likely need to be between 12 and 24 acres depending on local conditions (such as land availability and costs).	Pyrolysis is a thermal depolymerization process that uses high heat, high pressure, and little to no oxygen to produce products such as syngas, marketable crude oils, solid carbon, non-condensable gases or char (used as a solid fuel, soil amendment, and for industrial processes), and other chemicals. Pyrolysis also converts waste plastic into various types of hydrocarbons. It has the potential to divert plastics destined for the landfill, displace virgin fossil fuel production, and reduce greenhouse gas emissions. Hydrocarbons, including crude oil produced by Pyrolysis, can be marketed as feedstock for oil refineries, petrochemical processors, or consumed on site. Pyrolysis, like Gasification, is best suited for a homogeneous feedstock such as plastic materials or wood waste. The performance specifications for these outputs are based on Pyrolysis of clean (contaminant free) feedstock. Capital and operating costs are high as the technology is still developing and not commercially proven, particularly for MSW feedstock. In order to manage the expected waste from the low tonnage scenario, the Pyrolysis facility footprint would likely need to be between 12 and 24 acres depending on local conditions (such as land availability and costs).	Refuse Derived Fuel (RDF) is a technology where a product is manufactured from heterogeneous MSW to produce a more homogeneous fuel with an increased heating value per pound and fewer contaminants. RDF has been successfully used as a fuel in industrial operations such as electricity-generating plants (including Mass Burn plants, 13 in the US) and cement kilns. RDF Waste-to-Energy or Mass Burn facilities involve another step in the process which increases cost. Impediments to the development of RDF facilities processing MSW at scale include technical (chloride removal requirements for cement kilns, a target market), permitting (users needing to obtain solid waste facility permits) and competition (common feedstock such as construction and demolition [C&D] debris diverted from solid waste stream to comply with C&D ordinances and/or enhance financials) which have limited markets for RDF. For the low tonnage scenario, a RDF facility would generate significant amounts of fuel (estimated at 293,762 tons/year after processing or 80% of total tonnage) and having secure and stable markets to take the RDF is key to support this option. If there are limitations on the end markets for RDF, whatever is not sold would need to be stored or would potentially also have to be landfilled. The market for RDF is currently assumed to be limited in Washington State. A market analysis was not performed for this Study. One C&D waste processor was known to shred C&D waste and produce RDF for cement kilns in Canada (common market use in Canada) but is no longer in operation. Our team also did not find any facilities in Washington State that are currently processing MSW to produce RDF. In order to manage the expected waste from the low tonnage scenario, the RDF facility footprint was estimated to be approximately 5 acres in size

TETRA TECH

KING COUNTY, WASHINGTON
EVALUATION OF LONG-TERM DISPOSAL OPTIONS

TABLE 1A
COMPARATIVE EVALUATION SUMMARY
LOW TONNAGE (HIGH DIVERSION) SCENARIO
(367,202 TONS/YEAR)

	Waste Export by Rail (WEBR)	Mass Burn	Gasification	Pyrolysis	Refuse Derived Fuel (RDF)
Environmental[1] This criterion evaluates impacts on the environment: Energy Production (Non-Renewable Energy Demand), Water Consumption, Air Quality (Acidification Potential), Water Quality (Eutrophication Potential), Climate Change (Global Warming Potential), and Human Health Toxicity (Cancer Potential). The goal for this criterion is to minimize environmental impacts. Environmental impact factor metrics are based on existing impact assessment and inventory methods such as EPA's Tool for Reduction and Assessment of Chemicals and Other Environmental Impacts (TRACI)[2]. Greenhouse gas (GHG) factors are based on global warming potential from the Intergovernmental Panel on Climate Change's 5th assessment report, using a 100-year time horizon. The following tables present the environmental impact results for WEBR, Mass Burn, and RDF for seven different factors. For clarity, impacts are presented per stage, as follows: • Process: refers to the impacts due to the operations of the corresponding facility (such as the landfill or Mass Burn facility). • Transport: refers to the impacts due to the transport of waste material to and from the facility, including transport of ash from Mass Burn to the landfill (where applicable). • Offsets: refers to the impacts of energy generation (grid electricity, natural gas, and bituminous coal) that are offset by energy generated by the facility. These are impacts of generating grid electricity that do not occur when the facility sends electricity to the utility grid (replacing other electricity), impacts of natural gas that do not occur when the facility sends RNG into utility pipelines or other uses (replacing conventional natural gas), and impacts of bituminous coal that do not occur when the facility sends RDF to a cement kiln (replacing bituminous coal).Landfill gas collected from WEBR is equally split between generating electricity to send to the grid (replacing the average grid energy mix) and creating RNG (replacing conventional natural gas). Mass Burn	The analysis includes impacts from transporting waste by rail, landfill operations, and offsets from replacing grid electricity and conventional natural gas with products derived from landfill gas. __Non-Renewable Energy Demand – Energy Production__ (MJ) • Process: 278,674,811 • Transport: 39,975,003 • Offsets: (25,430,027) • **Net Total: 293,219,787** __Water Consumption – Water Quantity__ (LH20) • Process: 15,081,156 • Transport: 1,157,095 • Offsets: N/A • **Net Total: 16,238,251** __Acidification Potential – Air Quality__ (kg SO_2 eq) • Process: 97,302 • Transport: 190 • Offsets: (7,978) • **Net Total: 89,513** __Global Warming Potential – Climate Change__ (MT CO_2 eq) • Process: 44,432 • Transport: 3,094 • Offsets: (8,900) • **Net Total: 38,625** __Smog Formation Potential – Air Quality__ (kg O_3 eq) • Process: 6,443 • Transport: 2,947,152 • Offsets: (237,979) • **Net Total: 2,715,616** __Human Health Toxicity - Cancer Potential__ (CTUh) • Process: 4 • Transport: 0 • Offsets: (0) • **Net Total: 4**	The analysis includes impacts from facility operations, offsets from replacing grid electricity with energy recovered from the facility, impacts of exporting ash and inerts by rail to landfill, and impacts of transporting metals to recycling by electric truck. __Non-Renewable Energy Demand – Energy Production__ (MJ) • Process: 363,227,312 • Transport: 8,147,997 • Offsets: (615,545,487) • **Net Total: 244,170,177**[3] __Water Consumption – Water Quantity__ (LH20) • Process: 14,800,811 • Transport: 903,216 • Offsets: N/A • **Net Total: 15,704,027** __Acidification Potential – Air Quality__ (kg SO_2 eq) • Process: 68,511 • Transport: 42 • Offsets: (74,530) • **Net Total: (5,977)** __Global Warming Potential – Climate Change__ (MT CO_2 eq) • Process: 55,724 • Transport: 630 • Offsets: (36,663) • **Net Total: 19,691** __Smog Formation Potential – Air Quality__ (kg O_3 eq) • Process: 421,240 • Transport: 632,360 • Offsets: (1,750,789) • **Net Total: (697,190)** __Human Health Toxicity - Cancer Potential__ (CTUh) • Process: 3,814,632 • Transport: 0 • Offsets: (0) • **Net Total: 3,814,632**	The environmental impacts of Gasification for MSW in King County cannot be summarized as a whole or compared to other disposal alternatives as Gasification facilities that process MSW are uncommon. Reliable environmental impact data are not available for a significant number of MSW materials.	The environmental impacts of Pyrolysis for MSW in King County cannot be summarized as a whole or compared to other disposal alternatives as large-scale Pyrolysis facilities that process MSW are rare. Reliable environmental impact data are not available for a significant number of MSW materials.	The summary includes impacts from facility operations, offsets from replacing bituminous coal with refuse-derived fuel, impacts of exporting ash and inerts by rail to landfill, and impacts of transporting metals to recycling by electric truck. __Non-Renewable Energy Demand – Energy Production__ (MJ) • Process: 171,768,982 • Transport: 3,023,652 • Offsets: (939,356,644) • **Net Total: (764,564,011)** __Water Consumption – Water Quantity__ (LH20) • Process: 15,429,207 • Transport: 751,524 • Offsets: N/A • **Net Total: 16,180,730** __Acidification Potential – Air Quality__ (kg SO_2 eq) • Process: 26,234 • Transport: 18 • Offsets: (717,202) • **Net Total: (690,950)** __Global Warming Potential – Climate Change__ (MT CO_2 eq) • Process: 25,155 • Transport: 233 • Offsets: (97,020) • **Net Total: (71,632)** __Smog Formation Potential – Air Quality__ (kg O_3 eq) • Process: 2,819 • Transport: 254,949 • Offsets: (5,366,795) • **Net Total: (5,109,028)** __Human Health Toxicity - Cancer Potential__ (CTUh) • Process: 3,796,968 • Transport: 0 • Offsets: (0) • **Net Total: 3,796,968**

---

[1] The environmental impact parameters selected to represent model outputs were chosen for their wide use in life cycle assessments and in scientific literature. These represent global emissions, not local impacts. The following are definitions of the environmental criteria evaluated.
[2] Tool for Reduction and Assessment of Chemicals and Other Environmental Impacts (TRACI) | US EPA
[3] See Section 2.4.1.2 of the Study for context on assumptions for offsets due to out-of-state electricity sales.

TABLE 1A
COMPARATIVE EVALUATION SUMMARY
LOW TONNAGE (HIGH DIVERSION) SCENARIO
(367,202 TONS/YEAR)

	Waste Export by Rail (WEBR)	Mass Burn	Gasification	Pyrolysis	Refuse Derived Fuel (RDF)
generates electricity that is sent to the grid (replacing the average grid energy mix).RDF generates RDF that is used in cement kilns (replacing bituminous coal).Net total: presents the sum of process, transport, and offset numbers. Note that in some cases, the impacts of Human Health Toxicity – Cancer Potential round to zero but are not actually zero.	**Resource Conservation:** • Landfill gas is converted to electricity or renewable natural gas. **Compatibility with Waste Prevention & Recycling:** • Does not provide opportunity for waste prevention or recycling.	**Resource Conservation:** • Creates heat that can be used to generate electricity and/or industrial/residential heating. **Compatibility with Waste Prevention & Recycling:** • Metals removed during pre-processing for recycling. •	**Resource Conservation:** • Creates usable products such as synthetic gas (syngas) that can be used as a fuel, processed into industrial chemicals such as ammonia and methanol, and converted to renewable natural gas. **Compatibility with Waste Prevention & Recycling:** • Metals removed during pre-processing for recycling. •	**Resource Conservation:** • Creates products such as syngas, marketable crude oils, solid carbon, non-condensable gases or char (used as a solid fuel, soil amendment, and for industrial processes), and other chemicals. Pyrolysis also converts waste plastic into various types of hydrocarbons. **Compatibility with Waste Prevention & Recycling:** • Metals removed during pre-processing for recycling. •	**Resource Conservation:** • Creates a fuel with increased heating value that is used in industrial operations such as electricity-generating plants (including Mass Burn plants) and cement kilns. **Compatibility with Waste Prevention & Recycling:** • Metals removed during pre-processing for recycling. •
Economic This criterion evaluates estimated capital (cost to build) and operating (cost to staff, operate, maintain, etc.) cost and potential revenue (to offset costs) to determine a comparative cost/ton impact to the rate payer. Consideration is also given to financial risk with potential revenue impacts and need for additional infrastructure. The goal for this criterion is to minimize costs.	**Capital Costs (2040$):** • **$1,842,845 (total)** Includes 12 trailer super chassis (at $85,570 per chassis in 2023$) to dray rail car containers to the IMF. Inflation assumed at 3.5% annual. • **$184,284** (annualized) Annualized capital cost based on 10-year depreciation. **Operating Costs (2040$):** • **$43,019,782** (includes Transportation & Disposal [T&D] + Equipment Depreciation). ○ T&D Only = $42,835,498. ○ Equipment Depreciation = $184,284. • Rail Transport and Disposal Cost based on recent legacy contract rates for higher tonnage contracts at $65/ton in 2023$ (i.e. Snohomish at 700k+ tpy) adjusted to 2040$. Disposal cost approximately 30% of T&D cost based on recent procurement data for WEBR contracts.	**Capital Costs (2040$):** • **$738,023,705 (total)** Includes equipment, building, infrastructure, estimated land acquisition costs ($40/sf) and bond purchase cost at 2.5%). Inflation assumed at 3.5% annual. • Reference Facilities: Durham York Energy Center, Ontario, Canada & West Palm Beach Facility, Florida. Adjusted for tonnage at $1000/ton CAPEX and $55/ton OPEX in 2023$. • **$54,121,738** (annualized) Annualized cost based on debt service assumed at 4% for 30-year term per municipal funding. • Cost per ton amortized over 30 years includes reserves for facility upgrades on a periodic basis including major upgrades after year 30 with having paid down the principal on CAPEX. **Operating Cost (2040$):** • Operating Cost (annual): **$36,245,421** Includes labor, maintenance, materials, allowance for facility and equipment upgrades. Inflation assumed at 3.5% annual.	**Capital Costs (2040$):** • **$1,358,466,442 (total)** Includes equipment, building, infrastructure, and estimated land acquisition costs. Inflation assumed at 3.5% annual. • Reference Facility: High level capital costs for Gasification were based on a 110,000 ton per year facility in Edmonton, Canada. This facility was built in 2013 and is one of the largest Gasification facilities built in the past decade. Adjusted for tonnage at $1900/ton CAPEX and $69/ton OPEX in 2023$. • **$99,620,872** (annualized) Annual cost based on debt service assumed at 4% for 30-year term per municipal funding. • Assumes post-processing of syngas to methanol. **Operating Cost (2040$):** • Operating Cost (annual): **$45,471,529** Includes labor, maintenance, materials, allowance for facility and equipment upgrades. Inflation assumed at 3.5% annual.	**Capital Costs (2040$):** • **$1,345,958,271 (total)** Includes equipment, building, infrastructure, and estimated land acquisition costs. Inflation assumed at 3.5% annual. • Reference Facility: There are no reference operating facilities near the capacity needed for the Study. Since the components and feedstock are similar to Gasification, the unit capital and operating costs for gasification were applied. • **$99,620,872** (annualized) Annual cost based on debt service assumed at 4% for 30-year term per municipal funding. **Operating Cost (2040$):** • Operating Cost (annual): **$45,471,529** Includes labor, maintenance, materials, allowance for facility and equipment upgrades. Inflation assumed at 3.5% annual.	**Capital Costs (2040$):** • **$252,054,211 (total)** Includes equipment, building, infrastructure, and estimated land acquisition costs. Inflation assumed at 3.5% annual. • Reference Facility: Cost based on feasibility study for 100 TPD RDF facility for Metro Vancouver, adjusted for low tonnage scenario throughput. Adjusted for tonnage at $350/ton CAPEX and $60/ton OPEX in 2023$. • **$18,483,976** (annualized) Annual cost based on debt service assumed at 4% for 30-year term per municipal funding. **Operating Cost (2040$):** • Operating Cost (annual): **$39,540,460** Includes labor, maintenance, materials, allowance for facility and equipment upgrades. Inflation assumed at 3.5% annual.

TETRA TECH

KING COUNTY, WASHINGTON
EVALUATION OF LONG-TERM DISPOSAL OPTIONS

TABLE 1A
COMPARATIVE EVALUATION SUMMARY
LOW TONNAGE (HIGH DIVERSION) SCENARIO
(367,202 TONS/YEAR)

	Waste Export by Rail (WEBR)	Mass Burn	Gasification	Pyrolysis	Refuse Derived Fuel (RDF)
		• Ash Disposal of Residuals (annual): **$12,784,749** Estimated fly and bottom ash disposal at 20% of total tons, $97/ton Ash Transport & Disposal cost in 2023$. **Revenue (2040$):** • Electricity Sales (annual): **$4,039,217** Assumes $0.02/kWhr based on current rate for Spokane WtE facility discounted for potential interconnect costs and transmission costs for interstate sales and 20% parasitic load. • Recycling Sales (annual): **$1,318,015** Assumes 5% metal recovery at $40/ton for metal sales including transport. • Metals recovered after the combustion process so value less than for Gasification and Pyrolysis where metals are removed during pre-processing.	• Ash Disposal of Residuals (annual): **$15,341,698** Estimated ash disposal tons at 24% of total tons, $97/ton Ash Transport & Disposal cost in 2023$. **Revenue (2040$):** • Methanol Sales (annual): **$39,600,485** Assumes Methanol production (418L per ton of waste processed) then sell at discounted rate of 50% market value ($1.65/gal or $0.43/L) then include 40% parasitic load. Discounted market rate accounts for transport cost. • Recycling Sales (annual): **$2,306,527** Assumes 5% metal recovery at $70/ton for metal sales including transport due to better quality metals being pulled off during pre-processing than Mass Burn.	• Ash Disposal of Residuals (annual): **$15,341,698** Estimated ash disposal tons at 24% of total tons, $97/ton Ash Transport & Disposal cost in 2023$. **Revenue (2040$):** • Electricity Sales (annual): **$3,231,374** Assumes energy sales are 20% less than Mass Burn estimates. This is because more energy is needed to preprocess the material (utilizing more parasitic loads). Combustion temperature is not as high as Mass Burn so less recovered energy. • Recycling Sales (annual): **$2,306,527** Assumes 5% metal recovery at $70/ton for metal sales including transport due to better quality metals being pulled off during pre-processing than Mass Burn.	• MSW Disposal of Residuals (annual): **$6,425,325** Estimated disposal tons of non-marketable inerts at 15% of total tons, $65/ton WEBR MSW Transport & Disposal cost in 2023$. **Revenue (2040$):** • RDF Sales (annual): **$5,875,225** Assumes $20/ton in 2023$. • Recycling Sales (annual): **$2,306,527** Assumes 5% metal recovery at $70/ton for metal sales including transport due to better quality metals being pulled off during pre-processing.
	Cost per Ton: • Annual Capital (equipment) + Rail Transport and Disposal Cost = **$43,019,782**/Annual Tons (2040$) • **$65.28/ton (2023$)** • **$117.16/ton (2040$)** • **$165.24/ton (2050$)** • **$233.08/ton (2060$)**	**Cost per Ton:** • Annualized Capital + Operating Costs – Revenue = **$97,794,676**/Annual Tons (2040$) • **$148.40/ton (2023$)** • **$266.32/ton (2040$)** • **$315.56/ton (2050$)** • **$385.03/ton (2060$)**	**Cost per Ton:** • Annualized Capital + Operating Costs – Revenue = **$118,527,088**/Annual Tons (2040$) • **$179.86/ton (2023$)** • **$322.78/ton (2040$)** • **$344.36/ton (2050$)** • **$374.70/ton (2060$)**	**Cost per Ton:** • Annualized Capital + Operating Costs – Revenue = **$154,896,199**/Annual Tons (2040$) • **$233.65/ton (2023$)** • **$419.33/ton (2040$)** • **$481.75/ton (2050$)** • **$569.78/ton (2060$)**	**Cost per Ton:** • Annualized Capital + Operating Costs – Revenue = **$56,268,008**/Annual Tons (2040$) • **$85.38/ton (2023$)** • **$153.23/ton (2040$)** • **$195.73/ton (2050$)** • **$255.73/ton (2060$)**
	Financial Risk: • Potential that rates from short term contracts (5 to 10-year terms) increase when up for renewal (beyond projected inflation rate increase).in the future. ○ Railroads indicated preferred contract terms of 5 to 10 years when interviewed. However, existing and recently executed WEBR contracts between municipalities and waste companies have been longer terms,10 years terms with 1-to-5-year renewal clauses between parties. Contracts between waste companies and respective railroads are not public information unlike the contracts between public entities and the respective waste companies. • Significant regulatory changes may impact future rates.	**Financial Risk:** • Washington State's Clean Energy Transformation Act (CETA) restricts future grid electricity sales to retail customers limiting in-State sales to wholesale customers, and district heating or interstate sales. Study assumed discounted rate for electricity sales; any lower rates for revenue would deem option infeasible. • The Climate Commitment Act (CCA) requires cap and trade offset purchases estimated at an additional $4.92-$7.97 per ton. Potential increased costs due to future regulatory requirements and effective cost per ton increases if projected tonnages decrease (to pay off capital debt services). Effective cost per ton should also decrease once capital debt service is paid off. • Rates from short-term contracts for the WEBR component of Mass Burn could	**Financial Risk:** • No proven operations at scale. • Commodity sales limited due to clean, homogeneous feedstock requirements not conducive to MSW (primary reason not established at commercial scale), therefore, high risk of not being able to sell commodities.	**Financial Risk:** • No proven operations at scale. • Commodity sales limited due to clean, homogeneous feedstock requirements not conducive to MSW. Potential risk of no or nominal electricity sales.	**Financial Risk:** • Market potential limited in Washington due to permitting impediments (end users needing solid waste facility permits) and technical issues with chlorides (from salt content in MSW) requiring limited use for cement kilns which are target end users. • Requires removal of low energy value waste (i.e., inerts such as glass and rocks) which streams have to be landfilled. Limitations on end markets requires on-site storage or landfilling of whatever not sold. • Current lack of markets to take projected material volume of 293,762 tpy (80% of total tonnage). • If RDF cannot be sold, this would not be a viable technology option. Alternative for lack of markets would be disposal in landfill or WEBR at $65/ton.

TABLE 1A
COMPARATIVE EVALUATION SUMMARY
LOW TONNAGE (HIGH DIVERSION) SCENARIO
(367,202 TONS/YEAR)

	Waste Export by Rail (WEBR)	Mass Burn	Gasification	Pyrolysis	Refuse Derived Fuel (RDF)
	• Based on review of available existing contracts, contracted waste company for WEBR would incur any costs from a catastrophic event or emergency so the County would not be charged a higher rate for unusual and unforeseen events. • According to railroad reps –no need for new IMF to service KC. • Study assumes use of existing IMF infrastructure. Containers and any IMF improvements included in rail transport and disposal rate.	potentially increase when renewed or sent out to bid. • Significant regulatory changes may impact future rates (i.e. new EPA emission standards announced in January 2024 to strengthen Clean Air Act standards for large facilities that burn municipal solid waste). • In case of emergency or catastrophic event, back-up disposal option would be WEBR ($65/ton) or direct haul to a landfill.			• Future regulatory drivers to reduce fossil fuel use could provide incentives for RDF use.
Operating History This criterion evaluates proven performance (ability to handle amount of waste), safety record and compliance with environmental and regulatory requirements. The goal for this criterion is to have proven operating history of performance, safety, environmental and regulatory compliance at capacity needed.	**Proven Performance:** • 30 plus years of commercial operations at tonnage needed. **Safety Record:** • Good • Industry's safety-centered approach to investments and operations delivers overall improvements that have made the last decade the safest ever for rail. • Analysis of 2023 FRA Data per million train miles indicates that for all railroads, the derailment rate has dropped 30% since 2000; per carload, the hazardous materials (hazmat) accident rate is at its lowest ever and down 75% since 2000 based on preliminary data and Class I railroads' mainline accident rate is down 42% since 2000 but increased slightly compared to 2022. • Safety data specific to King County was requested from the UTC. In 2024, for non-Link Light Rail incidents, there were 8 crossing collisions, 1 crossing injury, 0 crossing fatalities, 4 trespass fatalities and 24 derailments. • Rail derailment is more significant than a truck spillage incident where typically only one truck is involved, spilling significantly less waste than a train carrying 80 to 100 intermodal containers depending on the specifics of the spill. The Washington State UTC does not provide detailed specifics on	**Proven Performance:** • Over 40 years of performance at operational scales required. • There has been a decline in number of facilities in the United States although not worldwide likely due to landfilling being a less costly alternative. **Safety Record:** • Good • Long operating facilities that upgrade periodically have a good safety record. • Recent fire occurred at Miami-Dade Mass Burn facility due to older facility with outdated fire controls.	**Proven Performance:** • No operating plants at proposed processing capacity. Largest facility known is 110,000 tpy and currently non-operational and about to be retired. **Safety Record:** • Unknown • No facilities currently in operation for comparison purposes.	**Proven Performance:** • Only known facilities are demonstration plants that are under 20,000 tpy. **Safety Record:** • Unknown • No facilities currently in operation with similar tonnage ranges.	**Proven Performance:** • Proven performance at small scale. No plants currently operating in similar tonnage ranges. There are RDF-based incinerators operating at scale that were not considered under Mass Burn due to the additional processing needs and higher costs. **Safety Record:** • Unknown • No plants currently operating in similar tonnage ranges.

TABLE 1A
COMPARATIVE EVALUATION SUMMARY
LOW TONNAGE (HIGH DIVERSION) SCENARIO
(367,202 TONS/YEAR)

	Waste Export by Rail (WEBR)	Mass Burn	Gasification	Pyrolysis	Refuse Derived Fuel (RDF)
	number of containers spilled during railroad accidents or derailments. **Environmental & Regulatory Compliance:** • Both BNSF and UPRR railroads comply with local, state, and federal regulations and are overseen at Federal level by FRA and at State level by Washington Utilities and Transportation Commission. • On April 22, 2022, Federal Railroad Administration announced Rail Industry Climate Challenge for owners and operators along national rail network and manufacturers of rail equipment to reach net-zero greenhouse gas emissions by 2050. It is not a law and railroads are not required to comply. • Although not a requirement, for the Study Environmental criteria analysis, an estimate of 30% biodiesel blend fuel was conservatively assumed based on existing UPRR-stated forecasts for the foreseeable future. • Regulatory changes such as more (or less) stringent emissions limits from diesel locomotives; other GHG measures can affect the amount of available rail capacity by 2040.	**Environmental & Regulatory Compliance:** • Long operating facilities that keep up with regulatory requirements - such as Best Available Control Technology standards - have good environmental record. • Old facilities are being shut down; newer facilities are much cleaner burning. • New facilities are subject to increasingly more stringent air emission standards (i.e. EPA's 2024 proposed emission standards for large facilities burning MSW), environmental and regulatory compliance requirements, and safety standards.	**Environmental & Regulatory Compliance:** • No facilities currently in operation for comparison purposes.	**Environmental & Regulatory Compliance:** • No facilities currently in operation with similar tonnage ranges.	**Environmental & Regulatory Compliance:** • No plants currently operating in similar tonnage ranges.
Logistics This criterion evaluates operating life of the facility and siting, design, permitting and construction requirements (e.g. implement ability, timelines) and compatibility with current collection and transfer systems. The goal for this criterion is to be logistically feasible, easier to design, site and permit (highly implementable) and compatible with the existing collection and transfer system.	**Operating Life of Facilities** (Years): • Based on current and projected waste disposal volumes, the 3 landfills have a combined life span of 300 + years. **Siting/Design/Permitting/Construction Considerations:** • The WEBR option for this study does not include siting, designing, and constructing a County owned IMF. • Some improvements may be needed at IMF to accommodate King County waste (cost included in rail transport and disposal rate).	**Operating Life of Facilities** (Years): • Based on projected waste disposal volumes, 20 to 40 years. **Siting/Design/Permitting/Construction Considerations:** • Siting and permitting difficult. • 7-10 years to site, design, permit and construct a site. 4 to 6 years for siting, 1 to 2 years financing and design and 2 years construction. • Factors depend on size of facility, zoning/land use & community involvement. • Industrial zoning, distance to sensitive receptors, ESJ and environmental impacts to be considered. • Strong regulatory drivers impacting feasibility such as CETA (restricting utility sales to retail customers due to not meeting renewable energy definition), CCA	**Operating Life of Facilities** (Years): • No known commercial operations to compare to. **Siting/Design/Permitting/Construction Considerations:** • Siting and permitting difficult. • 7-10 years to site, design and construct. 4 to 6 years for siting, 1 to 2 years financing and design and 2 years construction. • Factors depend on size of facility, local and state ordinances, and community involvement. • Industrial zoning, distance to sensitive receptors, ESJ and environmental impacts to be considered. • Although no known commercial operations, siting requirements expected to be similar to Mass Burn.	**Operating Life of Facilities** (Years): • No known commercial operations to compare to. **Siting/Design/Permitting/Construction Considerations:** • Siting and permitting difficult. • 7-10 years to site, design and construct. 4 to 6 years for siting, 1 to 2 years financing and design and 2 years construction. • Factors depend on size of facility, local and state ordinances, and community involvement. • Industrial zoning, distance to sensitive receptors, ESJ and environmental impacts to be considered. • Although no known commercial operations, siting requirements would likely be similar to Mass Burn. • No known commercial operations to compare design and construction to.	**Operating Life of Facilities** (Years): • 20 to 40 years based on smaller operating facilities. **Siting/Design/Permitting/Construction Considerations:** • Siting medium difficulty, especially if co-located at existing transfer station. • 5-7 years to site, design and construct. 3 to 5 years for siting, 1 year financing and design and 1 year construction. • Factors depend on potential to collocate with existing transfer station, size of facility, local and state ordinances, and community involvement. • Industrial zoning, distance to sensitive receptors, ESJ and environmental impacts to be considered. • RDF facilities in Washington may be considered waste processors (based on the feedstock content – if it includes MSW

TABLE 1A
COMPARATIVE EVALUATION SUMMARY
LOW TONNAGE (HIGH DIVERSION) SCENARIO
(367,202 TONS/YEAR)

	Waste Export by Rail (WEBR)	Mass Burn	Gasification	Pyrolysis	Refuse Derived Fuel (RDF)
		(requiring cap-and-trade credit and new 2024 EPA air pollution standards.	• No known commercial operations to compare design and construction requirements to. • Washington State's CETA and CCA regulations do not affect methanol production.	• Strong regulatory drivers impacting feasibility similar to Mass Burn.	components such as plastic vs. just wood waste) and, thereby, need to obtain solid waste facility permits which is an impediment. Historically, the financial benefit of using RDF was not enough to justify the permitting costs for cement plants.
	Compatibility w/Current Collection System: • High Compatibility. • Utilizing existing private sector-owned and operated facilities such as the BNSF or UPRR IMFs as part of a WEBR option for King County is compatible with the County/37 member jurisdictions' current collection systems.	**Compatibility w/Current Collection System:** • High Compatibility. • No or minimal pre-processing required.	**Compatibility w/Current Collection System:** • Low Compatibility. • Requires pre-processing of incoming waste to support Gasification units.	**Compatibility w/Current Collection System:** • Low Compatibility. • Requires pre-processing of incoming waste to support Pyrolysis units.	**Compatibility w/Current Collection System:** • Medium Compatibility. • Less stringent feedstock requirements compared to Gasification and Pyrolysis.
Social Impacts This criterion identifies potential disparate impacts to communities due to disposal options. The goal of this criterion is to provide social benefits to communities based on job creation and minimize social impacts on the livability and character of a community due to truck traffic, noise and odor. Odor and Groundwater Pollution related to disposal options (without considering location of facility). Definitions for Job Creation: • Minimal Skill - No prior skill or minimal training • Technical Skill - Requires an Associate's degree, technical certificate, or similar level of on-the-job technical training • Advanced Skill - Requires Bachelor, Masters, or other advanced degree or equivalent level of on-the-job training and years of experience	**Environmental & Social Justice (ESJ)/ Equity:** • Impacts on communities near IMF and around rail line to be considered when rail program is selected. Increased congestion near IMF and longer wait times at railroad crossings to be analyzed, including any mitigation measures, during project level SEPA analysis when location of Mixed Waste Processing Facility and IMF are identified. • Environmental impacts will be greater for frontline communities. • Economic impacts greater for low-income households because cost increases represent a higher share of their income than for other households. **Local Traffic Impacts:** • 80 (truck trips/day) To and from IMF from Mixed Waste Processing Facility. • Assumes each load is 28 tons. Used 362 workdays. • Truck trips based on peak daily tonnage of 9% over 2-year monthly average for period from 2021-2022. • Roundtrip Time Per Haul: 1.5 hours per truck trip. Assumes the drive time plus trailer hitching at both sites. • Traffic Impacts on regional transportation networks' roads and railroad lines (i.e. longer wait times at crossings). • Traffic impacts will be shifted from the vicinity of CHRL to the vicinity of the IMF	**Environmental & Social Justice (ESJ) / Equity:** • Future siting to identify communities around potential facility locations and transport corridors and evaluate per EPA's Environmental Justice Screening and Mapping Tool and Washington Environmental Health Disparities Map. • Environmental impacts will be greater for frontline communities. • Economic impacts greater for low-income households because cost increases represent a higher share of their income than for other households. **Local Traffic Impacts:** • 96 (truck trips/day) To and from Mixed Waste Processing Facility, IMF for ash disposal (20% of total tonnage) and metals (5% of total tonnage) recycler. • Assumes each load is 28 tons. Used 362 workdays. • Traffic impacts will be shifted from the vicinity of CHRL to the vicinity of the IMF and are therefore expected to be similar to that at CHRL.	**Environmental & Social Justice (ESJ) / Equity:** • Future siting to identify communities around potential facility locations and transport corridors and evaluate per EPA's Environmental Justice Screening and Mapping Tool and Washington Environmental Health Disparities Map. • Environmental impacts will be greater for frontline communities. • Economic impacts greater for low-income households because cost increases represent a higher share of their income than for other households. **Local Traffic Impacts:** • 103 (truck trips/day) To and from Mixed Waste Processing Facility, IMF for ash disposal (24% of total tonnage) and metals (5% of total tonnage) recycler. • Increased residuals for disposal compared to Mass Burn. • Assumes each load is 28 tons. Used 362 workdays. • Traffic impacts will be shifted from the vicinity of CHRL to the vicinity of the IMF and are therefore expected to be similar to that at CHRL.	**Environmental & Social Justice (ESJ) / Equity:** • Future siting to identify communities around potential facility locations and transport corridors and evaluate per EPA's Environmental Justice Screening and Mapping Tool and Washington Environmental Health Disparities Map. • Environmental impacts will be greater for frontline communities. • Economic impacts greater for low-income households because cost increases represent a higher share of their income than for other households. **Local Traffic Impacts:** • 103 (truck trips/day) To and from Mixed Waste Processing Facility, IMF for ash disposal (24% of total tonnage) and metals (5% of total tonnage) recycler. • Increased residuals for disposal compared to Mass Burn. • Assumes each load is 28 tons. Used 362 workdays. • Traffic impacts will be shifted from the vicinity of CHRL to the vicinity of the IMF and are therefore expected to be similar to that at CHRL.	**Environmental & Social Justice (ESJ)/ Equity:** • Future siting to identify communities around potential facility locations and transport corridors and evaluate per EPA's Environmental Justice Screening and Mapping Tool and Washington Environmental Health Disparities Map. • Environmental impacts will be greater for frontline communities. • Economic impacts greater for low-income households because cost increases represent a higher share of their income than for other households. **Local Traffic Impacts:** • 160 (truck trips/day) To and from Mixed Waste Processing Facility, IMF for WEBR residuals disposal (15% of total tonnage), metals (5% of total tonnage) recycler and RDF markets (80% of total tonnage). • Decreased residuals for disposal compared to medium and high tonnage scenarios. • Assumes all material received leaves the facility for disposal, recycling or end product markets. • Assumes each load is 28 tons. Used 362 workdays. • Traffic impacts will be shifted from the vicinity of CHRL to the vicinity of the IMF

	Waste Export by Rail (WEBR)	Mass Burn	Gasification	Pyrolysis	Refuse Derived Fuel (RDF)
	and are therefore expected to be similar to that at CHRL. **Local Job Creation** (Number of Operations Jobs and Category): • 8 jobs created. • Minimal Skill: 0 Jobs. • Technical Skill: 7 Jobs. • Advanced Skill: 1 Jobs. **Other Potential Neighborhood Impacts** (Odor, Noise, Air, Groundwater): • Air – Low Impact. Primarily emissions from truck and some rail transport in King County. • Odor – Low Impact. Primary source of odor is loading containers at Mixed Waste Processing Facility which would be similar to existing operations and unloading at IMF. • Noise – Medium Impact. Incremental impacts of the additional truck traffic from the county's waste being trucked into the facilities would likely increase noise and vibration issues. In addition, highway use and road wear would increase within the neighboring areas. Location in industrial zone would minimize impacts on residential receptors. • Groundwater – No Impact (at IMF). There is no impact to groundwater for the IMF unloading operations.	**Local Job Creation** (Number of Operations Jobs and Category): • 43 jobs created. • Minimal Skill: 4 Jobs. • Technical Skill: 24 Jobs. • Advanced Skill: 15 Jobs. **Other Potential Neighborhood Impacts** (Odor, Noise, Air, Groundwater): • Air – Medium Impact. Primarily CO^2, CO, NOx, VOC's, SO^2 emissions. Substantially reduced through regulatory requirements. • Odor – Low Impact. Primary source of odors are the trucks that enter the facility, the tipping floor where raw garbage is stored, any ash residue and potentially odor originating from the stacks (all are scrubbed and odor should be at a minimum). Facility is enclosed which significantly contains odor. • Noise – Medium Impact. Primary source are trucks entering the facility. In addition, highway use and road wear would increase within the neighboring areas. Some blower fans (pull emissions from the incinerator through the air pollution controls and up the stack) can also be loud. Facility enclosed which minimizes exterior noise. • Groundwater – No Impact.	**Local Job Creation** (Number of Operations Jobs and Category): • 43 jobs created. • Minimal Skill: 4 Jobs. • Technical Skill: 24 Jobs. • Advanced Skill: 15 Jobs. • Number of jobs created assumed to be similar to a Mass Burn facility as the operations are similar: front-end material handling, some pre-processing, loading, operating the combustion unit(s), post processing and residue management. • Depending on the combustion units needed, there may be higher FTEs required for Gasification and Pyrolysis but unknown at this time. **Other Potential Neighborhood Impacts** (Odor, Noise, Air, Groundwater.): • Air – Medium Impact. Primarily CO2, CO, NOx, VOC's, SO^2 emissions. Substantially reduced through regulatory requirements. Dependent on how biogases are used. Some air emissions may come after final scrubbing of biogas, dependent on what process is employed on the backend. • Odor – Low Impact. Primary source of odors are the trucks that enter the facility, the tipping floor where raw garbage is stored, any ash/residue and potentially odor originating from the stacks (most are scrubbed, and odor should be at a minimum). In addition, highway use and road wear would increase within the neighboring areas. Facility is enclosed which significantly contains odor. • Noise – Medium Impact. Primary source are trucks along traffic routes and entering the facility. Some ID/FD fans (pull emissions from the incinerator through the APC and up the stack) can also be loud. Facility enclosed which minimizes exterior noise.	**Local Job Creation** (Number of Operations Jobs and Category): • 43 jobs created. • Minimal Skill: 4 Jobs. • Technical Skill: 24 Jobs. • Advanced Skill: 15 Jobs. • Number of jobs created assumed to be similar to a Mass Burn facility as the operations are similar: front-end material handling, some pre-processing, loading, operating the combustion unit(s), post processing and residue management. • Depending on the combustion units needed, there may be higher FTEs required for Gasification and Pyrolysis but unknown at this time. **Other Potential Neighborhood Impacts** (Odor, Noise, Air, Groundwater): • Air – Medium Impact. Primarily CO2, CO, NOx, VOC's, SO2 emissions. Substantially reduced through regulatory requirements. Dependent on how biogases are used. Some air emissions may come after final scrubbing of biogas, dependent on what process is employed on the backend. • Odor – Low Impact. Primary source of odors are the trucks that enter the facility, the tipping floor where raw garbage is stored, any ash/residue and potentially odor originating from the stacks (most are scrubbed, and odor should be at a minimum). In addition, highway use and road wear would increase within the neighboring areas. Facility is enclosed which significantly contains odor. • Noise – Medium Impact. Primary source are trucks entering the facility. Some ID/FD fans (pull emissions from the incinerator through the APC and up the stack) can also be loud. Facility enclosed which minimizes exterior noise. • Groundwater – No Impact.	and are therefore expected to be similar to that at CHRL. **Local Job Creation** (Number of Operations Jobs and Category): • 37 jobs created. • Minimal Skill: 4 Jobs. • Technical Skill: 18 Jobs. • Advanced Skill: 15 Jobs. **Other Potential Neighborhood Impacts** (Odor, Noise, Air, Groundwater): • Air – Low Impact. Primarily equipment emissions. • Odor – Low Impact. Primary source of odors are the trucks that enter the facility and the tipping floor. Facility is enclosed which significantly contains odor. • Noise – Medium Impact. Primary source are trucks entering the facility. In addition, highway use and road wear would increase within the neighboring areas. Facility enclosed which minimizes exterior noise. • Groundwater – No Impact.

TABLE 1A
COMPARATIVE EVALUATION SUMMARY
LOW TONNAGE (HIGH DIVERSION) SCENARIO
(367,202 TONS/YEAR)

	Waste Export by Rail (WEBR)	Mass Burn	Gasification	Pyrolysis	Refuse Derived Fuel (RDF)
			• Groundwater – No Impact.		
Capacity This criterion evaluates the ability of options to handle different types and required volumes of waste. It considers the composition of waste required to make option viable, waste acceptance (i.e., special waste handling), minimum level of waste required to make option viable, flexibility in operating low and high volumes, and residue disposal requirements. The goal for this criterion is to ensure needed capacity, provide processing flexibility in waste types and volumes and maximize types of waste.	**Capacity/Minimum Waste Requirements** • Technology is capable of processing amount of waste from this tonnage scenario including projected amount of 366,266 tpy by 2060. • Both serving railroads indicated that tonnage scenario volumes could be accepted although traffic and congestion as capacity is used on railroads can be a factor in the future. • Four major types of change can affect the amount of available rail capacity in 2040: Global Economic, Political, Climate or Regulatory Changes.	**Capacity/Minimum Waste Requirements** • Technology is capable of processing amount of waste from this tonnage scenario including projected amount of 366,266 tpy by 2060.	**Capacity/Minimum Waste Requirements** • Technology is still in development. Not capable of processing amount of waste from this tonnage scenario including projected amount of 366,266 tpy by 2060.	**Capacity/Minimum Waste Requirements** • Technology is still in development. Not capable of processing amount of waste from this tonnage scenario including projected amount of 366,266 tpy by 2060.	**Capacity/Minimum Waste Requirements** • Technology is capable of processing amount of waste from this tonnage scenario including projected amount of 366,266 tpy by 2060.
	Waste Type Composition & Acceptance: • High waste acceptance. • All non-hazardous MSW accepted at 3 landfill disposal facilities. • No requirements for the waste composition presorting or elimination of certain wastes, except the following: White Goods, Sharps, Batteries, Tires, Vehicles, Used Oil.	**Waste Type Composition & Acceptance:** • High waste acceptance. • All non-hazardous MSW accepted. • Broad acceptable criterion. Can take a broad range of energy values and material types. • Mass Burn can accept a wider range of acceptable wastes than can Pyrolysis, Gasification and RDF where end users have very specific feed stock requirements. • For metals – tonnage scenario may not matter. But will change the energy value. • Most of the metal that is intact in the ash can be extracted. • A screening process is typically used to reduce the size of incoming bulky items and large inerts from the refuse feed chute. • Bulky items would need to be pre-processed ahead of time before they enter the refuse feed chute. Most bulky items removed at Mixed Waste Processing Facility prior to receipt.	**Waste Type Composition & Acceptance:** • Low waste acceptance. • A Gasification facility that processes MSW is uncommon, considered developing and not commercially proven. Preprocessing of waste stream needed to produce a uniform sized feedstock with little to no inert materials. • Processes homogeneous feedstock such as biomass (organics/wood waste), plastics, coal or tires. Using Gasification technologies to process MSW is considered developing and not commercially proven. • Thermal characteristics of the waste streams should be similar for the three waste diversion scenarios. • Pre-processing required which includes shredding equipment to meet sizing specifications, magnets and eddy current separators to remove ferrous and non-ferrous metals, and densifiers to remove inert materials such as glass, rocks and masonry to create feedstock with improved thermal properties of the waste stream.	**Waste Type Composition & Acceptance:** • Low waste acceptance. • A Gasification facility that processes MSW is uncommon, considered developing and not commercially proven. • Preprocessing of waste stream needed to produce a uniform sized feedstock with little to no inert materials. • Outputs from Pyrolysis include marketable crude oil, solid carbon residuals, non-condensable gases, and dissolved organics. The performance specifications for these outputs are based on Pyrolysis of clean (contaminant free) feedstock.	**Waste Type Composition & Acceptance:** • Medium waste acceptance. • An RDF plant is technically a Mixed Waste Processing Facility with an end product, therefore feedstock selection will vary based on material extraction protocols to meet end user requirements. • Raw (as-received) MSW is pre-processed (shredders, screens, air jets) to produce a more uniform-sized product, with the intent of retaining higher-BTU materials such as paper, cardboard, and plastic. Ferrous metals can be removed with a magnet while aluminum can be removed with an eddy current separator. Removal of metals, which are non-combustible, increases the heating value of the RDF. Heating value can also be increased by removing other non-combustible inert materials such as broken glass, dirt, rocks, and concrete. • Significant technical and economic challenges in processing raw garbage to remove chlorine (in food waste) from RDF intended as cement kiln fuel (a target market). Chlorine is a deleterious material in Portland cement.
	Tonnage Flexibility: • High Flexibility. • Both serving railroads indicated that all 3 waste tonnage scenario volumes could be	**Tonnage Flexibility:** • Medium Flexibility. • Has a broad acceptable criterion. Can take a broad range of energy values and material types.	**Tonnage Flexibility:** • Low Flexibility. • Most Gasification facilities are demonstration or pilot plants that process under 20,000 tons per year, none operating at the tonnage required.	**Tonnage Flexibility:** • Low Flexibility. • Large scale Pyrolysis facilities for MSW are rare. Pyrolysis, like Gasification, is best suited for a homogeneous feedstock such as plastic materials or wood waste. These	**Tonnage Flexibility:** • Low Flexibility. • Biggest impact on tonnage capacity for RDF is the lack of markets (due to technical and permitting challenges) to take the projected materials under the Study's three

TABLE 1A
COMPARATIVE EVALUATION SUMMARY
LOW TONNAGE (HIGH DIVERSION) SCENARIO
(367,202 TONS/YEAR)

	Waste Export by Rail (WEBR)	Mass Burn	Gasification	Pyrolysis	Refuse Derived Fuel (RDF)
	accepted. However, high range scenario would need 3-5 years of pre-planning. • Back-up alternative to WEBR should be identified and included in contract for emergencies or catastrophic events.	• One-time emergencies or catastrophic event addressed in design of back-up systems such as redundant process lines, equipment and storage (on-site or alternative sites). • Back-up alternative facility should also be identified for emergencies or failures.	• There is a MSW Gasification facility in Edmonton, Canada that is designed to process 110,000 tons per year. However, this facility is not performing as designed and is about to be retired. • One-time emergencies or catastrophic event addressed in design of back-up systems such as redundant process lines, equipment and storage (on-site or alternative sites). • Back-up alternative facility should also be identified for emergencies or failures.	types of homogeneous facilities have been able to achieve performances that are more efficient in terms of energy efficiency, carbon intensity, and resource productivity. However, capital and operating costs remain high as the technology is still developing and not commercially proven. • Most Pyrolysis facilities are demonstration or pilot plants that process under 20,000 tons per year, none operating at the tonnage required. • One-time emergencies or catastrophic event addressed in design of back-up systems such as redundant process lines, equipment and storage (on-site or alternative sites). • Back-up alternative facility should be identified for emergencies or failures.	tonnage scenarios. Competition is another factor. • Most RDF feedstock in North America is from ICI or C&D sources due to only high energy materials that can consistently be converted to RDF and are, thereby, attractive to the end users. These sources of RDF feedstock material are always looking for non-landfill destinations of their sorted materials to enhance financials and/or to comply with C&D diversion requirements competing with any MSW-based RDF-produced by King County. • RDF facility may need to blend or treat the feedstock with another waste stream (i.e. tire fluff) in order to produce a more consistent BTU/energy level to satisfy end consumers increasing volume to be sold. • Back-up alternative facility should be identified for emergencies or failures.
	<u>Residual Waste Management</u> <u>(Disposal or further processing):</u> • No residual wastes generated.	**<u>Residual Waste Management</u>** <u>(Disposal or further processing):</u> • Residual ash would need to be disposed of in a separate ash monofill. • Rejected waste such as oversized or non-combustible items will also require transport to a landfill.	**<u>Residual Waste Management</u>** <u>(Disposal or further processing):</u> • Residuals disposal likely required in an ash monofill. • May contain hazardous compounds. Market for biochar end-product uncertain. • Rejected waste such as oversized or non-combustible items will also require transport to a landfill. • Recyclables such as recovered metals will need to be hauled away for off-site recycling.	**<u>Residual Waste Management</u>** <u>(Disposal or further processing):</u> • Residual ash disposal required in an ash monofill. • Rejected waste such as oversized or non-combustible items will also require transport to a landfill. • Recyclables such as recovered metals will need to be hauled away for off-site recycling.	**<u>Residual Waste Management</u>** <u>(Disposal or further processing):</u> • Many non-combustible and inert materials that are removed during the RDF process can be sent to recycling markets or landfilled, if no markets are available. The estimated disposal tons of non-marketable inerts for this scenario is 15% of total tons. • There will be no ash generated from an RDF facility.

Energy Production (Non-renewable energy demand) (Unit of Measurement: MJ): Measures fossil and nuclear energy from point of extraction. Includes coal, natural gas and oil which exist in limited quantities in nature. The Non-renewable Energy Demand factor alone is not as meaningful as the impacts of the non-renewable energy demand that are measured in other criteria such as GHG emissions.

Water consumption (Unit of Measurement: L H_2O)**.** Freshwater that is evaporated, incorporated into products and waste or disposed into the sea. Most of water consumption impacts in LTDOS occur due to processing or energy offsets, particularly energy offsets related to the hydropower portion of grid electricity.

Air Quality (Acidification potential) (Unit of Measurement: kg SO_2 equivalents): Potential environmental damage caused by release of acid-forming compounds into atmosphere, primarily due to burning of fossil fuels and biomass.

Water Quality (Eutrophication potential) (Unit of Measurement: kg N eq)**:** Potential environmental damage caused when bodies of water or soil become overly enriched with nutrients, primarily due to pollutants released into the environment such as nitrogen and phosphorus. Key plant nutrients, are added in large quantities causing rapid growth of algae in water bodies, leading to increase in oxygen which can kill fish and other aquatic life. Can also disrupt natural species balance and reduce ecological diversity

TETRA TECH

KING COUNTY, WASHINGTON
EVALUATION OF LONG-TERM DISPOSAL OPTIONS

TABLE 1A
COMPARATIVE EVALUATION SUMMARY
LOW TONNAGE (HIGH DIVERSION) SCENARIO
(367,202 TONS/YEAR)

Climate Change (Global warming potential) (Unit of Measurement: MT CO2 eq): Potential increase in Earth's temperature due to GHGs emitted by human activities. Main GHG is carbon dioxide released primarily through burning of fossil fuels like coal, oil and natural gas. Another significant GHG is methane, which comes from breakdown of organic materials in environments without oxygen such as wetlands or landfills.

Smog formation potential (Unit of Measurement: kg O3 eq)**:** Process by which certain chemicals in the atmosphere react with sunlight and heat to produce ozone, a major component of smog. Typically occurs when nitrogen oxides and VOCs, which are released during the combustion of fuels like gasoline and diesel, interact under certain conditions. Ozone at ground level is harmful as it can cause respiratory problems and other health issues, as well as damage vegetation.

Human Health Toxicity (Cancer Potential) (Unit of Measurement: CTUh): Dangers to people's health from release of toxic chemicals into the environment are significant. These chemicals can cause various health problems such as different cancers. Measures the probable increase in cancer related morbidity (from inhalation or ingestion) for the total human population per unit mass of chemical emitted.